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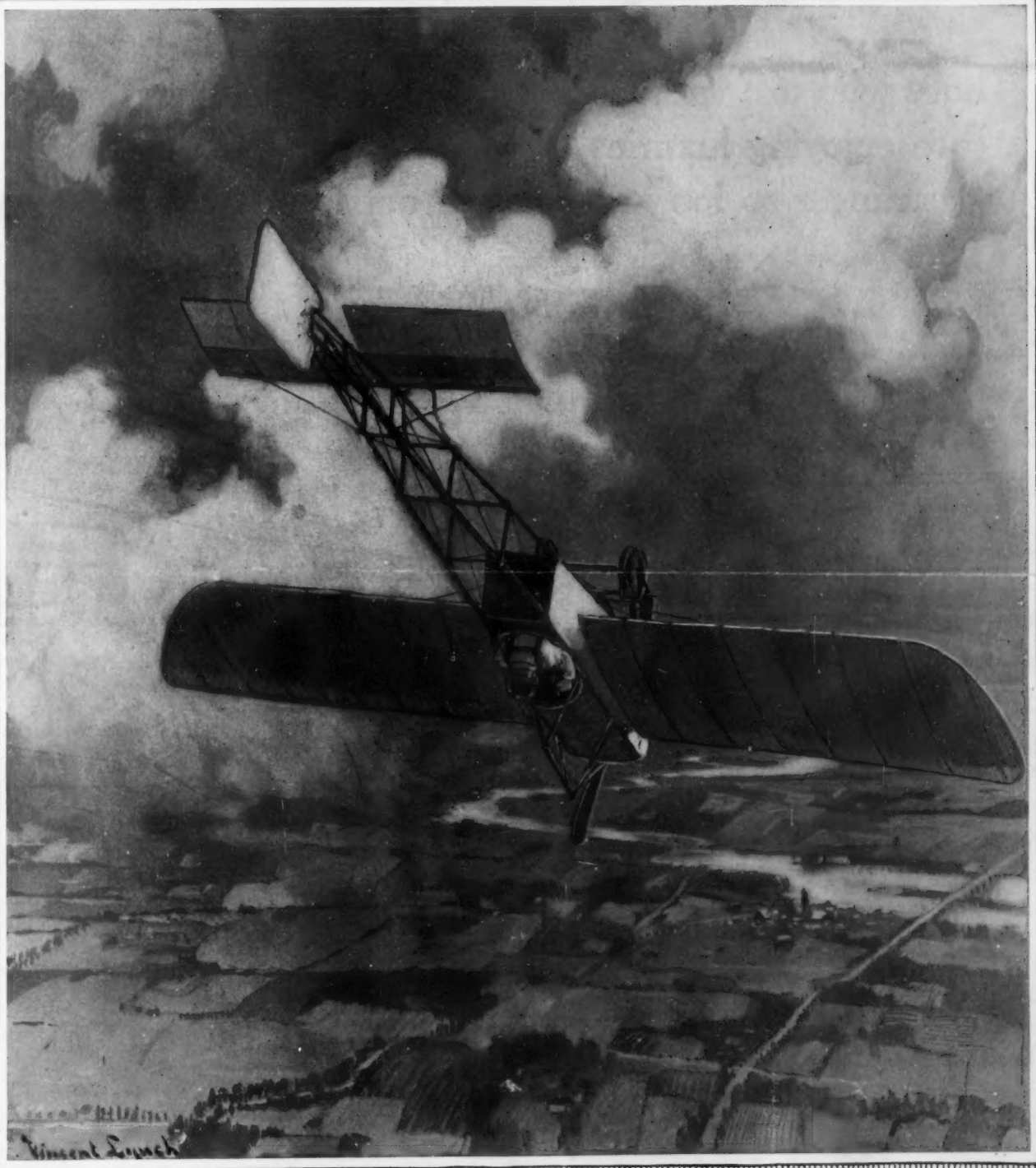

Earthquakes and the Panama Canal

Pegoud—Somersaulting Aviator

His exploits described by an eye witness

Vol. CIX. No. 16
October 18, 1913

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

Cadillac

Standard of the World

Those who are within the world of Cadillac ownership are enjoying luxuries to which you must remain a stranger so long as you are outside that world

Motoring as you know it, and motoring as the owner of a 1914 Cadillac knows it, are two distinct and different things.

The new Cadillac neither rides nor drives like any other motor car.

It is not that the two speed direct drive axle has changed the principle of the Cadillac engine.

But it has conferred upon it, powers which it did not possess without it.

It has altered the performance—changed the character of that performance—and changed the sensations resulting from that performance.

So, those who are within the world of Cadillac ownership, are enjoying luxuries to which you must remain a stranger so long as you are outside that world.

And they are marked, these differences—these peculiar luxuries of the Cadillac.

So marked, that we doubt if you can drive the memory of them out of your mind after a single ride in the Cadillac.

They are not easy to describe—though you will be conscious of them before the car has traveled half a mile.

But, let us see if we can give you an idea.

You know what the Cadillac—and the Cadillac engine—were before the advent of this 1914 car.

You know that it was notably free from tremor.

You know that it did not lunge forward, but forged forward, majestically, like a battleship.

These were the natural fruits of Cadillac construction—refined and developed to an extraordinary degree.

And now, new qualities and new functions have been conferred upon it, by means of a second—supplemental—principle.

This other principle—the two speed direct drive axle—takes the Cadillac at its high point of development and extends it.

The new Cadillac axle has two direct drive gear ratios.

Eliminating all technicalities from the subject, the advantage of the high direct drive gear ratio consists in the fact that through it, a given speed of the engine produces an increase of 42 per cent in the speed of the car.

Out of this central improvement grow these differences in operation to which we have referred.

Keeping in mind the more slowly moving engine, *you sense at once that infinitely greater steadiness must follow.*

Holding fast to the same mental picture, *you see that vibration must be reduced almost to the vanishing point.*

Imagine the car with the low direct gear, operating at an engine speed of 700 revolutions per minute.

The car will travel 21 miles per hour.

Shift the electric switch and pass into the high direct drive gear ratio, and the speed of the car increases to 30 miles an hour *with no increase in the speed of the engine.*

Unconsciously, when you change gears, you look forward to the apparent effort and labor of the engine to be increased.

It does not come.

The trembling does not come.

No shock, no disturbance is communicated to the car or its occupants.

The steady pressing onward of the car is uninterrupted—the smoothness is continuous.

You forget the engine, you forget the car. There is only quiet—and a soft swinging through space.

Is it any wonder that Cadillac owners are volubly enthusiastic?

They have this velvety mode of travel of which you have yet to learn.

They have attained it by methods which lower the fuel consumption, decrease friction and reduce appreciably the cost of operation.

They have artistic body designs which make it difficult to suggest any sense in which their beauty could be heightened.

They have progressive, scientific engineering development.

They have the certainty of the Cadillac Delco system of electrical cranking, lighting and ignition.

They have the improved Cadillac carburetor, hot water jacketed and electrically heated.

They have entrance and exit for front seat passengers on either side,—right hand drive and right hand control with all of its advantages and no disadvantages.

They have the simple electric switch for shifting from high direct to low direct gear, or vice versa.

They have Cadillac standardization, true alignment and interchangeability of parts.

They have the product of an organization inspired by the highest ideals.

They have the Cadillac glorified and refined.

They have a car entitled to the distinction,

"Standard of the World."

STYLES AND PRICES

Standard Touring Car, five passenger $1975.00

Seven passenger car $2075.00	Roadster, two passenger $1975.00	Inside drive Limousine, five passenger . . $2800.00
Phaeton, four passenger 1975.00	Landaulet Coupe, three passenger . 2500.00	Standard Limousine, seven passenger . . 3250.00

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Cadillac Motor Car Co. Detroit, Mich.

SIXTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CIX
NUMBER 16.

NEW YORK, OCTOBER 18, 1913

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Cutting Down the Pittsburgh "Hump" District

By Harry Chapin Plummer

THERE is rapidly approaching completion in Pittsburgh what is known as the $5,000,000 "Hump" improvement. In less than two years the grades of streets aggregating 2.16 miles in length, forming an area of 33 acres, which had long been known as the "Hump," have been reduced by a maximum cut of 16.3 feet. The physical undertaking alone, exclusive of the outlay following condemnation proceedings, has cost $690,000.

The work has been of benefit principally to Fifth Avenue, one of the city's chief arteries of business traffic, and the work has centered about the handsome Allegheny County Court House, one of the finest public buildings in the country, the Frick and Carnegie office buildings, both "skyscrapers," and the County Jail. Prior to the commencement of cutting operations, Fifth Avenue had a grade of 7½ per cent, which rendered the thoroughfare actually dangerous for traffic, at times when the pavements were wet with rain, or were ice-coated in the winter. Moreover, the narrowness of the street combined with the steep grade to cause an almost constant congestion.

To effect the needed improvement, it was necessary to cut away the crest of the "Hump," and by this change the ground floors of the massive buildings fronting upon Fifth Avenue became the second floors and the basements became the street floors. This necessitated sweeping alterations, not only in the very structure of each of the buildings, but in the entrances and lobbies and elevator facilities. The lower portion of the façade of each of the office buildings has been practically remodeled.

As the result of these improvements, the grade has been reduced from 7.5 to 4.8 per cent. The improvement in the grade and the architectural treatment of the lower portion of the buildings is strikingly shown in the accompanying illustrations.

The work of cutting through a street, house and store so as to lower the grade of Pittsburgh's Fifth Avenue from 7.5 to 4.8 per cent.

Cut of 14.9 feet, whereby the first floor, occupied by a savings bank, becomes the second and the institution must remove to the new street floor.

Fifth Avenue in the "Hump" district after the completion of cutting away the crest of the hill. The old and new grades.

If Ants Were as Big as Men

SPENCER in his "Principles of Biology" has shown that the power of assimilation in animals is dependent on the surface of the digestive duct, and that it varies as the square of the dimensions of the body, whereas the consumption of material is proportional to the cube of the same dimensions, so that the ratio of the two factors decreases at the same rate as the size of the animal increases.

This principle, as pointed out in the *Revue Scientifique* by Dr. Yves Delage, is of the highest importance in understanding biological phenomena and leads to a number of interesting conclusions only partly enunciated by Spencer.

It has frequently been suggested that the ant is relatively stronger than either man or horse. The insect can carry on its frail legs a grain of corn ten times the weight of its body, whereas man and horse carry loads equivalent only to the weights of their bodies. The inference that the ant is greatly superior from the point of view of its structure and strength, can be shown to be erroneous by the following considerations: Suppose an ant to grow in all directions to twice its original dimensions, but still retaining its geometrical and histological structure. Its volume and accordingly the weight of its body will increase eight-fold. The muscles likewise grow to twice their original dimensions; but since their increase in length does not alter their strength, which is only proportional to their cross-section, the ant increased to eight times its weight is only four times as strong as before, that is, carries only forty times its original or five times its present weight; in fact, it is in proportion only half as strong as before. If now the same ant grew in all directions to dimensions, not two but a thousand times their original figure, thus reaching the size of a man or horse, it would be a thousand times weaker than before, being able only to carry 1/100, instead of ten times, its own weight.

Delage terms the ratio of the power of assimilation to the consumption of the body its "physiological efficiency," and accordingly enunciates the theorem that this factor decreases at the same rate as the size of the body augments. This theorem applies to physiology as well as to ontogeny and phylogeny.

1. *Physiology.* Since practically all organs producing substance useful for the organism, as well as those serving to eliminate waste materials, are hollow organs depending for their working capacities on their surface, while the consumption of those substances and the production of waste materials depend on the volume, Spencer's proposition, as modified by Delage, will be readily understood.

2. *Ontogeny.* The morphogenous phenomena of ontogeny consist mainly of invaginations and protrusions by which the organism with its complicated forms and internal organs is produced from the round egg. When the development of the embryo has come to an end, the organism has reached its maximum physiological efficiency, which accounts for the fact that its growth is then the most rapid. As the growth of the organism continues, the physiological efficiency, however, decreases, and when the productive powers just balance the consumption of the body, growth comes to an end under normal conditions. The equilibrium thus reached will last for a long time. Any deterioration of the body (by disease, etc.), however, reduces its power of assimilation, whereas its consumption remains practically unaltered, that is to say, the physiological efficiency of the body decreases, and this continual decrease eventually results in the death of the individual.

3. *Phylogeny.* When considering the evolution of various phyletic pedigrees, a striking parallelism is noted between the physiological efficiency and the ontogenesis of individuals. In fact, each such pedigree commences with small, slightly differentiated forms, in order by gradual evolution at last to arrive at highly differentiated forms of considerable dimensions, which eventually vanish, thus extinguishing the whole pedigree. Since the physiological efficiency of large-sized animals is very low, the ultimate extinction of these species will be readily known.

Doubtless there are other factors as well at play in connection with these phenomena, but the "physiological efficiency" of individuals and species may certainly claim a paramount position as a determining factor.

Fine Specimen of Mammoth Found in Siberia

THE Natural History Museum of Paris now possesses a fine specimen of mammoth with the flesh parts preserved to a certain extent. The specimen was offered to the museum by the Count of Stenbock-Fermor who found it in one of the islands of the Siberian region. After extracting it at his own expense he brought it to Europe by sled, boat and railroad. This is probably the only specimen of the kind which central Europe is to possess, for the Russian government has issued a ukase prohibiting any export of the mammoth, either entire or in part. Such animals preserved in the ice have been known since 1806, but the only specimen preserved under these conditions up to the present and brought to Europe is to be found at the museum of the Academy of Sciences at St. Petersburg.

Lately the Russian scientists have been engaged in studying the fleshy parts from the standpoint of anatomy, histology and the like, and these researches are expected to yield some valuable data. As to the Paris specimen, it is well enough preserved to allow of carrying on similar researches, and these are already in progress under Prof. Boule's direction. Before long the animal will be exposed to the public and it will be one of the attractions of the museum.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

A Dangerous Bill

AS a matter of international courtesy, it was right for Representative Kahn of California to introduce in the House a bill which will enable exhibitors at the Panama-Pacific Exposition to import free of duty articles and building materials intended for the Exposition. But does international courtesy demand that the Librarian of Congress and the Commissioner of Patents be required to record "any certificate of registration, copyright, trade mark, or patent issued by any foreign government," so as to protect the foreign exhibits at the Exposition?

Clearly, the purpose of the measure is not only to permit foreigners to escape our duties, but also to prevent the citizens of this country from manufacturing, using and selling imported articles of merchandise not patented in this country, but exhibited at the Exposition. As the bill is now phrased, it matters not that the foreign exhibitor never applied for a patent in this country. Indeed, the bill would give him protection even though his exhibit might not be protectible under our copyright, trade mark or patent laws. Was there ever a measure more clearly unconstitutional?

Our patent laws are open to citizens of foreign countries. We grant patents to foreigners on exactly the same terms as we grant them to the citizens of our own country. If any inventor fails to take advantage of the patent laws the public may appropriate his invention. A law which seeks to afford protection to foreign exhibitors at San Francisco in violation of the constitution and our own patent laws would be class legislation and an infringement of the rights of the citizens of this country to use unpatented articles freely.

Bills such as this testify to the urgent need of some advisory body which will point out the flaws of well-meant, but foolish legislation, and which will avoid hours of useless debate in Congress. The patent laws are particularly shining marks for ill-informed Congressmen. Hardly a year passes but some absurd bills are introduced which seek to curtail the very limited privileges that inventors now enjoy—bills which are framed by legislators who have not the slightest realization of the part played by patented inventions in the up-building of this country, and which a well-informed advisory board would promptly relegate to the limbo of bad dreams.

"Dual Personality" in Court

WAS Dr. Jekyll legally responsible for the crimes of Mr. Hyde? This question was recently decided in the affirmative by an English jury, but the precedent established seems rather to point to a defect in the law than to insure justice in the settlement of such cases in the future. The case in question was notable for the scientific evidence adduced on behalf of the accused.

A young engineer named George Chetwynd, of good social standing, was charged with the theft of a motor-car belonging to one of his friends, a Doctor Barron. The accused was alleged to have broken into the doctor's garage, removed the car, altered its number, and, as he had no money, secured some gasoline on credit before making off with the machine. A curious feature of the affair was that the accused knew where the key of the shed was kept and also where the doctor kept his supply of gasoline, but did not avail himself of this knowledge. After being arrested and lodged in jail, the prisoner appeared to come out of a trance, and professed to have no recollection of what he had done.

The owner of the car seems to have been willing to drop proceedings, but the public prosecutor insisted on a trial. Counsel for the defense admitted that his client had committed the theft, but declared that, when doing so, he had been in a condition known to medical men as "automatism."

Dr. Parry Jones, of Derby, stated his belief that the case was one of automatism, and that the accused was not morally responsible for his actions. He cited a number of similar cases from medical records.

The weightiest evidence, however, was that of Dr. Hyslop, one of the highest English authorities on mental diseases. He pronounced the condition of the accused to be one of mental automatism, which was midway between somnabulism and a minor form of epilepsy. In such a condition a person may perform complicated mental and physical actions, yet have no recollection of them on recovery. Unfortunately for the accused, Dr. Hyslop declined to qualify the case as one of insanity, and this technical distinction, coupled with the inelasticity of the laws, probably left the jury no alternative but to decide as they did. The same expert raised a curious question in ethics by stating, on cross-examination, that (to quote the report of the case in the *Times*) "there were cases of mental automatism in which the abnormal irresponsible self knew at the time what it was doing, but the normal self would have no recollection of it." In other words, self *A* knowingly breaks the law, but before the case comes to trial has ceased to exist, and is replaced by self *B*, which has no knowledge of the crime—in fact, did not commit it. How is justice to be done in such a case?

In his charge to the jury the judge took an easy way out of the difficulty by adopting a skeptical attitude toward the mental phenomenon in question. The jury found the accused guilty, and he was sentenced to four months in jail.

Of course, the outstanding fact is that, regardless of the merits of this particular case, the phenomenon of dual personality does sometimes occur, and may lead to a situation analogous to that of Jekyll and Hyde. If Hyde knowingly does wrong shall Jekyll be punished? Probably if such cases were more common the law would provide for some form of restraint, as in cases of insanity, but would not inflict the opprobrium of a jail sentence upon the unfortunate possessor of a dual personality only one of whose "egos" was addicted to crime.

Painting the Town With Phosphorescent Paint

EVERY clear day there is poured upon walls and buildings an immense amount of solar energy, causing in many instances such a glare of brightness that men adopt various screens and obstacles to relieve the strain upon the sensitive nerves of vision. The only attempt that appears to be made to utilize these surfaces seems to be the requirement, in certain large cities, that the rear and inner walls of buildings shall be painted white, in order to check the absorption of light, and relieve the darkness of inner courts and ventilating shafts. Every day this brilliant display of solar energy is allowed to be absorbed, reflected, dissipated, while upon every succeeding night there is expended a costly effort, in power-houses, gas-works, and oil-combustion, to produce such feeble efforts at illumination as will render possible the prolongation of activity for a few hours.

In view of the results which have been attained in the efforts to utilize storage methods for the electric current, it seems most desirable that some similar system for retaining at least a portion of this illuminating sunshine may become practicable.

It is well known that there are a number of substances which possess the so-called power of "insolation;" that is, the capacity of being so influenced by the action of the rays of the sun as to emit a certain degree of luminosity. Although the substances which have been most generally employed for the demonstration of this peculiar property are numerous, the power is possessed by them in a rather feeble degree, and the best of them costs considerably more than would permit its general employment. It seems possible, however, that the property of emitting light for a considerable period of time after exposure to brilliant sunlight, as possessed by the sulphides of calcium or strontium, for example, might be developed to a far higher degree if the subject were investigated with the same care and skill as have been given to the examination of materials for the manufacture of incandescent gas mantles, for instance. It seems probable that a thorough and vigorous study of the subject of phosphorescence, and the development of new compounds for the increase of the property of insolation, would place the matter upon a commercial basis to an extent comparable with other methods of deriving artificial illumination.

The method of employing such phosphorescent materials would be so greatly simplified over existing systems of lighting, as to demand interested attention. All that would be necessary would be to prepare the material as a paint and spread it upon the surfaces of buildings, especially those exposed to brilliant sunlight during the day, in order to enable the same surfaces to return the stored sunlight during the night, and thus provide an automatic equalization of the light energy of the sun. The principal cost of such a method would be that involved in the preparation of the luminous paint, and in the maintenance of the clean surfaces, since the operation of absorption and emission of the light would require no further attention, all mechanical devices being conspicuous by their absence. The general use of such a paint would enable the more powerful methods of artificial illumination to be limited to special locations, and confine the use of existing systems to indoor service and points to which so little daylight penetrated as to provide insufficient insolating action upon the phosphorescent material. Such a method as indicated seems to offer possibilities as great as any effort to discover the manner of producing the feeble cold light of the glow worm, or the firefly, and since it offers a plan for the direct utilization of one of the elements of the radiant energy of the sun which has hitherto remained uncontrolled, it appears to be well worthy of serious study. With the equipment of existing chemical and physical laboratories, it should be possible to press our knowledge of the phenomena of phosphorescence and fluorescence to a point far beyond that now obtaining, and the reward of a successful solution of the problem would be so great in itself as to render unnecessary the provision of any other prize to the successful investigator.

The Direction of Aerial Highways

AMONG the eastern tales which M. Antoine Galland brought from Constantinople about two hundred years ago, there was one about a mountain of lodestone, which destroyed ships by attracting and drawing out all the iron nails. This was before the days of manufactured electricity and of electro-magnets, and no one knew of the existence of magnetic waves which might be used to transmit signals, and help vessels instead of injuring them, but it did include the germ of a truth which has only begun to be appreciated, and even as yet but little utilized. To-day the influence of magnetism supplies not only the magnetic needle, by which a guide for direction is provided, but it also enables shore stations to send out time signals, checking the chronometer, and insuring correct determinations of longitude.

It is possible that there may yet be developed such a control of magnetic lines of force as will enable air routes to be directed in a manner even more definite than the lanes in which transatlantic steamers are operated.

One of the greatest difficulties which appears in the way of long-distance aerial journeys, assuming the practicability of continuous flight, is that of maintaining the desired direction, in the midst of clouds and fog, and in the darkness of the night. The vibration of the machine, and the difficulty of taking observations of position, even in clear weather, render it most desirable that some positive and direct guidance be furnished, not limiting the machine to such a close line as to involve possible collision with others, but indicating definitely the route along which progress should be made.

Hertz has indicated the practicability of directing magnetic waves, and Tesia has proposed definite trains of electrical waves, and it seems as if further work along these lines might result in the development of a method of indicating air routes, independently of any observations of the compass or of celestial bodies. The existence of a definite train of waves through space, say from New York to London, which would immediately indicate to the airman the fact that he was in the right road, probably by the response of a sensitive detector, would permit him to dispense with any other effort to direct his machine except to keep it within the path of magnetic effect, and to watch for any material deviation from the path. Such a method would be wholly apart from any attempt to transmit energy by means of waves; that is, sufficient energy to be capable of use as propelling power, but it would energy by means of waves, that is, sufficient energy gator that he was proceeding in the direct path to his destination, in whichever direction he might be headed.

It is not improbable that the successful introduction of such directive regions would later lead to the supply of motive power through space and thus remove one of the chief practical difficulties to long-distance aerial travel, the limitations of fuel supply. Each development in such work leads on to the next, and the surest way to attain such a result as a stream of directed radiant energy over a determined route would seem to be the provision, at first, of a guiding line, which might later become something more.

Engineering

Turbine Casings Purchased Abroad.—By purchasing the turbine casings for the battleship "New York," now building at the New York navy yard, from Cammel, Laird & Co., the Navy Department will save $102,000 on the cost of these casings, had they been purchased of the lowest American bidder.

The Busiest Railroad Terminal.—Although the Grand Central Station, New York, is the largest, it is not the busiest terminal in America. Statistics for the year ending June 30th, 1913, showed the total number of passengers in and out of the Grand Central Terminal was 22,403,295, whereas for the same year the total for the South Station at Boston was 38,411,507. Of this total, 28,347,399 represented passengers of the New York, New Haven and Hartford Railroad Company's lines, and 10,064,108 were passengers on the Boston and Albany line.

Sixteen-inch Gun to be Mounted.—The experimental 16 inch, coast-defense gun, which was built a dozen years ago at the Watervliet Arsenal, is no longer a "white elephant" at the Sandy Hook Proving Ground, to which it was sent for test. The gun stood its trials satisfactorily; but because big guns such as this went out of favor and were displaced by high-velocity, 12-inch guns, the big piece has lain for a decade, at Sandy Hook. A disappearing gun carriage, however, is now being built to carry the piece, and it will form part of the battery of the defenses of the Panama Canal.

The Safety of Steel Trains.—In a letter to the New York *Times*, the well-known signalman, James O. Fagan, endeavors to make out a case against the steel car on the ground that, because of its greater weight, it is more destructive to roadbeds, bridges and general structures than the wooden cars. But it is not the weight of the car but the weight of the very heavy engine that controls this question. Bridges and tracks have been or should be strengthened to accommodate the great increase in engine weight, which has been so large as to render the increase in the weight of steel cars over wooden cars of minor importance.

"Safety First" Time Tables.—There has been a revision of the time tables of the New Haven Railroad, the guiding principle of which was consideration of the safety of the passengers. This road operates about 2,000 trains every day in the week, and of these some two thirds are affected, notably the through trains and long distance local trains. The running time of the New York to Boston through trains has been increased by from 6 to 20 minutes. When the road bed, rolling stock and signal system have all been brought up to absolutely first class condition it will be time to return to faster schedules.

Demand for Tractors.—At the present time there is a good demand for automobile tractors in English South Africa, the principal reason being the epidemics of horse disease (epizootic) which cause a great diminution in the number of horses in this region, so that power wagons are becoming indispensable for carrying on agricultural work. The kind of automobile needed for local use should be of simple and substantial makeup, suitable for use with plows and harrows, and for hauling material. Efforts are being made of late by the agricultural associations in order to promote the use of power wagons, and especially of tractors combined with plows.

Largest Marine Diesel Engine.—The recent arrival of the ship "Wotan" in New York Harbor, is of interest because the ship is propelled by a single-screw, six-cylinder, two thousand horse-power Carels-Diesel marine engine. Other motor ships that have come to this port, were driven by two engines of 6 or 8 cylinders, whose gross capacity was about 2,000 H. P. and in each case they were supplied with injection air by additional engines. The motor of the "Wotan" is a six-cylinder engine with an injection air compressor on the engine. This is the largest marine Diesel engine in service, and the good record of the ship on her maiden voyage is another proof of the reliability of this type of drive.

Two Additional East River Tunnels.—It is only a few years since the construction of a subway tunnel below the East River excited wide-spread interest because of the difficulty and magnitude of the undertaking; but to-day we have got into the way of building tunnels under that river almost as though they were commonplace forms of engineering work. Two new tunnels are to be built in connection with the dual subway. The Interborough tunnel leaves Manhattan at Old Slip and runs under the East River to Clark Street, Brooklyn; the other tunnel to be built by the New York Municipal Corporation will extend from Manhattan at Whitehall Street below the East River to Montague Street, Brooklyn. When these two tunnels are completed, Manhattan and Long Island will be joined by twelve separate tube tunnels and by four of the greatest bridges of the world, through and over which will be about 50 separate lines of track.

Electricity

Double Telegraphone Records.—Prof. Pedersen is taking up the Poulsen telegraphone or magnetic phonograph idea and now perfects it so that excellent results are to be had. He runs a steel wire between a pair of bobbins, and upon the wire are placed electromagnets nearly touching it, as usual, so that when he speaks into a telephone connected with the magnets, this gives a magnetic record upon the wire as it passes along, but here he uses two separate magnets spaced on the wire, and finds he can thus record two separate conversations on the same wire. On reversing the wire, each conversation can be heard in its own telephone.

Stopping Trains Electrically.—Experiments have recently been made on the Bavarian State Railways with a method of stopping railway trains electrically. The system is referred to as one of wireless telegraph communication between a wire strung on the roof of the baggage car and any telegraph or telephone lines running along the track. Probably induction is used rather than Hertzian waves to convey the signal to the train. The apparatus operates either a bell or a light signal in the cab of the locomotive or it will operate directly on the air brakes. The system calls for the installation of a sending station at frequent intervals, so that if it be desired to stop a train because of some acciden', this may be effected from almost any point along the track.

Cadmium Storage Battery Plates.—Förseke and Aschenback use a new process for making cadmium electrode plates for alkaline accumulators. They use cadmium obtained in finely divided form as a spongy precipitate from a solution of cadmium salt. In order to obtain it, they add zinc powder to a solution of cadmium chloride. Then the precipitated spongy cadmium, mixed with zinc powder and a small amount of oxide of mercury, is spread upon suitable supports for making the battery plates. Such porous cadmium electrodes are used in a caustic soda or potash bath against a nickel electrode. At the first charging by current, the mercury oxide is reduced to the metallic state and the mercury then envelops the particles of cadmium and zinc. On discharging the battery, the zinc dissolves out, while the cadmium becomes oxydized and the mercury remains in the same state and is not affected. The zinc thus remains only temporarily in the mass, and aids in rendering it porous.

Locomotives for the Milan-Varese Railroad.—There are now in use five electric locomotives of quite a new build upon the electric railroad running from Milan to Varese. This road is 60 miles in length and uses a third rail with 650 volts direct current. Several substations along the road receive high tension current at 53,000 volts from a power line, and feed current into the road at the reduced tension. Hitherto the electric railroad used motor cars for the trains, and also one electric locomotive, but it recently had the five locomotives to which we refer built by a Milan works. These are of the Brown-Boveri type and have three driving wheels and two carrying wheels. On the locomotive are two 1,000 horse-power motors placed above the level of the wheel rims. All three wheels on a side are coupled to a common driving rod bar. The rod is also connected with each of the motor cranks by a pair of bars, so that the two motors drive the three wheels in an efficient manner. The new locomotives serve for freight and passenger trains and can make 60 miles an hour. The total weight of the locomotive is 72 (long) tons and adhesive weight 45 tons.

Exhausting Lamp Bulbs at High Temperature.—A new method is used for making a vacuum in incandescent lamps or other glass vessels. Heretofore, to eliminate the last traces of moisture and expel air bubbles which adhere to the side of the glass, the lamps have been heated in a special furnace lined with asbestos to equalize the heat to a temperature of 250 or 350 deg. Cent. (482 or 662 deg. Fahr). But all the air bubbles do not detach even at this heat, and a greater heat cannot be used for fear of softening the glass, when the air pressure would collapse the bulbs. Quite lately the Berlin Allgemeine Company used a vacuum process which allows of heating to a higher point and to go even up to softening of the glass while the lamps are on the air pumps. This is done by placing the lamps in an electric furnace in which a vacuum is made, so that there is scarcely any external pressure on the lamps and they can now be heated as high as 500 deg. Cent. (932 deg. Fahr.). Larger end tubes can be used on the lamps which is better for the vacuum process, but it is a hard matter to fuse off such large tubes for closing, when they have a vacuum inside, as collapsing may occur. An original method is used for this, and a spiral wire electric heater surrounds the tube so that it is softened and can be drawn out while still inside the furnace, and the closing off of the lamp thus effected without air pressure on the outside. When this is done, the furnace is allowed to cool down to 350 deg. Cent. before opening and putting on the atmospheric pressure.

Science

An Austrian South Polar Expedition, now being organized, is expected to sail from Trieste in May, 1914, under the leadership of Dr. F. König, of Graz, in the ship "Deutschland," recently used by Lieut. Filchner's Antarctic expedition. Dr. König is a geologist and an experienced Alpine climber, and took part in Filchner's expedition to Spitzbergen in 1910.

Geocentric Altitudes of Mountains.—In one sense Mt. Everest is the highest mountain on the globe, but in another sense it is overtopped by at least 25 other peaks. Prof. August von Bohm has calculated the "geocentric" altitudes of 31 high mountains; i. e., the distance of their summits from the center of the earth. Chimborazo, in the Andes, stands at the head of the list; Everest stands near the bottom, and is, geocentrically, about 1.3 miles lower than its South American rival.

A Mining Exposition will be held in Horticultural Hall, Philadelphia, the week of October 20, in connection with the Annual American Mining Congress. It will include, among other things, exhibits of mining machinery rescue and first-aid apparatus, and safety appliances. Several big coal companies will send rescue and first-aid crews, which will give exhibition drills, while the United States Bureau of Mines will be represented by one of its safety cars and a picked crew of helmet men. Among the industrial exhibits it is proposed to have a gold-mining camp in full operation, with a mill crushing the ore.

The Sanitation of Soda Fountains.—An urgent and apparently neglected question is discussed by Dr. W. S. Rankin in the *Bulletin* of the North Carolina Board of Health. This writer finds the solution of the problem in the use of paper paraffin cups and saucers. These can be sold at about half a cent apiece. In the process of manufacture they are dipped into melted paraffin, and are practically sterile; they are put up in stacks, and in using them at the fountain the attendants do not touch the inside of the cup or the upper third of it. Of course the cup is thrown away after once being used. The spoons used with ice cream should be dipped into an antiseptic solution before the customer is served.

Water Power Development in the Scottish Highlands was discussed by Mr. A. Newlands at the last meeting of the British Association. The possibilities of the Highland region in this direction appear to have been strikingly neglected. Its high mountain ranges, lochs fed from large drainage areas, a rainfall ranging from 60 to 100 inches per annum at high altitudes, steep and rapid rivers, good transportation facilities, and sturdy industrial population seem to mark it out as a favored site for hydroelectric undertakings. A start has been made at Kinlochleven and Foyers, where the British Aluminium Company already generates 30,000 and 7,000 horse power, respectively, and there are a number of smaller installations, but for the most part this field is unworked.

Wireless Weather Reports for Mariners, issued by the United States Weather Bureau, are now distributed broadcast every evening shortly after 10 o'clock by the Naval radio stations at Radio (Arlington), Va., and Key West, Fla. The report consists of two parts; the first giving in a simple figure code the barometric pressure, wind-direction, and wind-force (on the Beaufort scale) prevailing at 8 o'clock the same evening at Sydney (N. S.), Nantucket, Atlantic City, Cape Hatteras, Charleston, Key West, Pensacola, and Bermuda; the second giving, in words, a forecast of the probable winds for the next two days over specified sections of the Atlantic and Gulf of Mexico, extending about a hundred miles offshore, and warnings of severe storms as occasion may arise.

Radium Emanation in Medicine.—The distinguished English surgeon, Sir Frederick Treves, recently stated that radium emanation is just as effective for curative purposes as radium itself. Assuming that radium is really the valuable therapeutic agent which it appears to be, the announcement is of great importance. Radium is extremely precious, for a small quantity of radium can produce practically an unlimited quantity of very cheap emanation. Radium emanations contained in sealed metal applicators are being sent off daily to all parts of England for medical men to use on their patients who cannot attend the Radium Institute. In a space of ten days emanations equal in curative value to $86,000 worth of radium have been sent out. Radium emits three sets of rays, designated respectively by the Greek letters, "alpha," "beta" and "gamma." The first two destroy the healthy tissues of the body when directed at close range, and at greater distance stimulate the abnormal tissues of tumors to renewed growth. The "gamma" rays are those which are desired. The more or less undesirable "alpha" and "beta" rays are filtered out by lead screens, through which the hard "gamma" radiations pass easily.

Gasoline Slot Machine

TAKING its cue from the fortunes that have resulted from the harvest of pennies dropped into chewing gum slot machines, and with the advantages of such automatic vending devices apparent, a Michigan company recently has placed on the market the gasoline vending slot machine that is shown by the accompanying illustration. The machine, which is quite as automatic in action as are its gum vending predecessors, has a number of features equally attractive to the man who puts in his money and receives gasoline, and to the man who puts in the gasoline and receives the money. In operation, it is merely necessary for the person requiring gasoline to drop a fifty-cent piece in the slot, place the end of the flexible hose in his gasoline tank and turn the crank. The machine is equipped with a gage—visible in the picture—to show whether it is full or empty, and even if a person should inadvertently place his money in the slot when the tank is empty it is promptly returned at the first turn of the crank, just as your penny is returned when the chewing gum slot machine is empty. Of course, as much more than fifty cents worth as is wanted can be obtained—up to the capacity of the tank—though a fifty-cent piece is the only coin that may be put into the slot. So that the device can be used anywhere, regardless of the fluctuating price of fuel, it is equipped with a metering mechanism which can be adjusted to deliver the proper amount of gasoline for the amount of money put into the slot.

A gasoline slot machine for automobilists.

The machine that is shown by the picture has been installed by a garage proprietor in the city of Lansing, and he is particularly "tickled" with it, for it requires no attendant, is positive and unfavoring in action, is always ready to serve anyone with the necessary coin, and left to itself dispenses some 200 gallons of fuel a week. As the machine requires no attention once it has been properly installed, it is obvious that garage proprietors are not the only ones who may benefit by its usefulness; anyone may install one and be assured of a profit. Not only does the machine run without attention other than that required in filling the "gas" tank, but it is capable of "delivering the goods" any minute in the twenty-four hours and any driver who knows of its location has no need to awaken sleepy garage attendants in the middle of the night—provided he is able—to obtain the wherewithal to get home.

On the other hand, it is evident that a vending machine liable to hold fifty or a hundred half-dollars would be a magnet for thieves unless placed where it would be constantly under the eye of an attendent.

Combined Piano Player and Talking Machine

THE deficiencies of the phonograph in the reproduction of piano music are only too well known. In most of the vocal productions, the accompaniment, if played on the piano is often so weak and banjo like that the piece would not suffer much if it were entirely omitted. To overcome this defect, attempts have been made to supply a real accompaniment by using an automatic piano-player with the phonograph. But the difficulties of synchronizing the two instruments have hitherto been deemed almost insuperable.

Recently, however, an inventor has succeeded in combining the two instruments, so that they are perfectly timed. This he accomplishes by pneumatic means controlled by a series of perforations in the music roll. On an 88-note player, the duct for the highest note, which is seldom used in the score, is utilized to control the pneumatic coupling. The exact method the inventor is not ready to disclose at the present time, as his patents are still pending, but apparently the music roll is brought into synchronism with the phonograph record at each turn of the latter. It is the phonograph that controls the *tempo* of the player-piano. The operator of the player-piano does not touch the *tempo* controlling lever, but he may operate the expression lever, or control the volume of sound by pumping harder or softer as the case may be. Any standard player-piano may be used to which a small attachment is applied, but the talking machine requires special apparatus for the control of its motor mechanism. Otherwise the talking machine is also of standard make and standard records may be employed.

The instrumental record is made by an expert, who plays an accompaniment on a piano electrically connected with a recording mechanism, while the vocal selection is being produced by the phonograph. The music roll is then cut in accordance with the record, and reproduced in the usual way.

The arrangement is such that the player-piano may play a prelude of any desired length, after which the phonograph will start up automatically. As the singer retards or accelerates, the player-piano will correspondingly vary its *tempo*. At the end of the vocal selection, both instruments will stop, playing, or if desired, the player-piano may play a postlude. The inventor of this combined mechanism is Mr. Charles F. Stoddard, who has done much toward the development of automatic piano players.

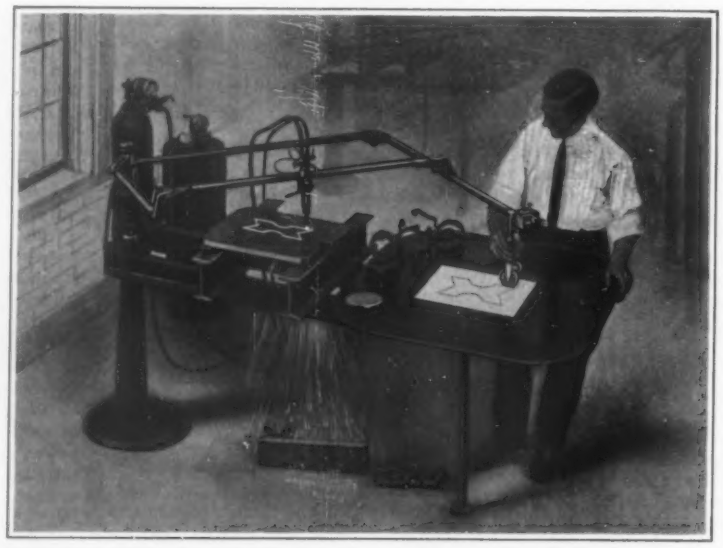
Talking machine and player piano operating in synchronism.

A Pantagraph Which Draws on Steel With a Point of Flame

By Henry Harrison Suplee

FROM the earliest times it has been assumed that a given material can be cut only by the use of another and harder material. To-day it is being learned that the hard, keen edge of the cutting tool may well be replaced through the irresistible action of the burning tool, by the intense heat of the oxygen-acetylene blowpipe.

The old idea of the use of heat in industrial operations carried with it the impression that a very large quantity of heat necessarily accompanied all operations which required very high temperatures. It is now well understood that there exists, in the oxy-acetylene gas burner, a workman's tool which is giving him vastly increased capabilities, not only in operations such as welding and fusing, but also in cutting through steel, even of very considerable thickness. Instead of a hard and keen cutting edge, the new tool does its work with a point of such an intensely high temperature that nothing can resist it, while the total amount of heat evolved is so moderate that portions of the metal immediately adjacent are unaffected.



A pantagraph cutting on metal with a burning jet.

The power which such a tool places in the hands of the intelligent mechanic is enormous, and, in fact, can be appreciated only by those who are familiar with the labor and energy formerly required to cut an irregular shape from a piece of tough and resistant material. To be able to cut out a piece of any desired shape, simply by passing the almost invisible apex of a cone of combining gases, is such a revolution in the art of the mechanic, that its possibilities are, as yet, scarcely grasped.

In order that such a powerful device may be used to the highest degree of efficiency it is desirable that special apparatus for use in connection with various operations should be devised, and considerable progress has already been made in this direction. The ordinary cutting tool has to be used in a machine tool which is capable, not only of holding the work and of providing the desired movements, but also of enabling sufficient power to be applied to force the cutting edge through the resistant metal. When, however, the cutting edge is replaced by the intensely hot point of the new tool, there is little need for apparatus for holding the work, or for power to propel it. All that the workman has to do is to move the light and convenient tip over the surface of the metal which lies quietly before him, and the path of the apex of gases, with its six-thousand-degree temperature, appears as a clean cut through the metal. The power required for the steel tool is replaced in the new method by another form of energy, by the heat of the jet, an infinitely more direct application than that which required the transformation into power through the medium of furnace, boiler, and engine, and the losses of transmission by belting or electric conductor.

It is desirable, however, that some method be provided to aid in guiding the movement of the jet over the surface of the metal. The power of the flame renders any false movement irrevocable, and there should be no uncertainty in its movements. The very nature of the operation renders the use of any ordinary template impracticable, and it is not easy to follow directly any marks drawn directly upon the surface of the metal.

It has been found, however, that as an apparatus originally devised for use in the drafting room for copying and enlarging drawings, the pantagraph may be employed most satisfactorily, only instead of drawing with a pencil upon a sheet of paper, it cuts through a plate of steel with a point of flame.

With the tracing point located at some distance from the reproducing point, the

(Concluded on page 309.)

Bleriot and Pegoud

Pégoud's Remarkable Performances

What Coolness and Nerve Can Accomplish

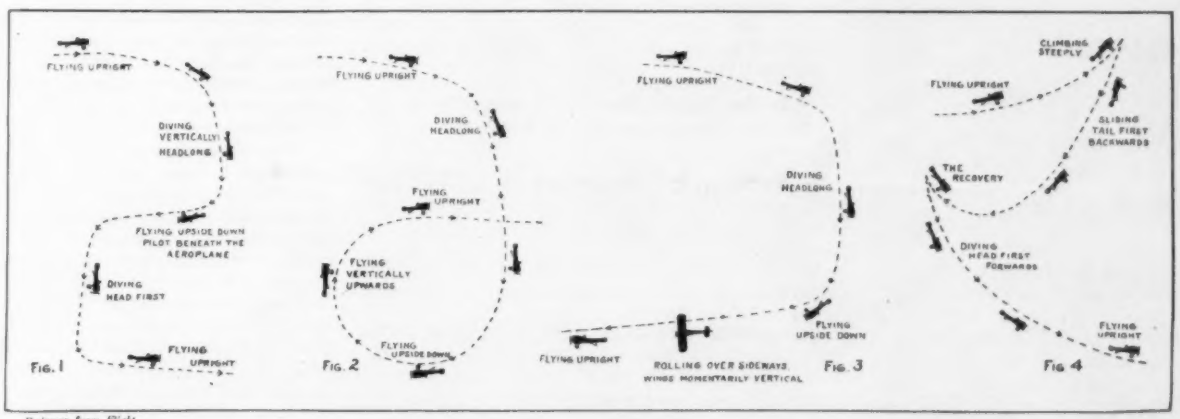
Pegoud rolling over sideways.

ALTHOUGH the name of Pégoud has been acclaimed in all the newspapers of the world, his remarkable exploits still fascinate. He has shown that a cool head and good nerves can accomplish undreamed of marvels in a flying machine, and that if an aviator is high enough he can always save himself if he side-slips or capsizes. As the accompanying illustrations show, Pégoud has deliberately placed himself in the most precarious positions conceivable—positions in which unfortunate aviators have found themselves in the past and have plunged to their doom. Pégoud's performances are therefore not to be lightly dismissed as worthless and reckless acrobatic performances.

A writer in *Flight*, who evidently witnessed Pégoud's flights, makes some interesting comments on flying upside down and on "looping the loop" in a monoplane.

There are four definite and distinct feats in Pégoud's *repertoire*, we are told.

The first is illustrated diagrammatically in Fig. 1, and in order to avoid confusion it may be explained that these diagrams are drawn in elevation. That is to say, they show the path of flight as it appears from the side of the machine. If this page is held upright, then the diagram represents as near as possible what Pégoud does against the background of the sky. These maneuvers take place at a great altitude, and to a certain extent they are thus witnessed by the spectators from beneath, which tends, naturally, to foreshorten the apparent vertical distances.



Redrawn from *Flight*.

The positions assumed by Pégoud when flying upside down, "looping the loop," rolling over sideways, and diving tail first.

Fig. 1 shows an absolutely vertical dive followed by a "flattening out" *upside down*.

"In an ordinary steep glide," comments the writer in *Flight*, "the machine is 'flattened out' so as to bring the pilot into an upright position once more: in his own special feat, however, Pégoud just tucks the head of his Blériot monoplane underneath him, and flattens out upside down.

"Having flown upside down for some little distance, he then dives again, and flattens out the right way up. The whole maneuver is controlled by the use of the elevator.

"Looping the loop is effected with the pilot on the *outside* edge. Pégoud dives as usual in order to gain momentum, tucks the nose of his machine under him as he does for the upside down flying, and keeping his elevator lever well forward, he continues his circle until he comes to the top of the arc, where he is flying level, and right way up once more. This maneuver is shown in Fig. 2.

"The third contortion involves the use of the warp as well as the elevator. Falling vertically head down as before and turning on to his back, Pégoud warps his wings to the utmost limits of the control and *rolls* over sideways into an upright position. This is shown, as clearly as it is possible to do so diagrammatically, in Fig. 3."

There remains yet one other "standard" accomplishment. Pégoud climbs steeply upward until his machine comes to a standstill, and so he provokes a deliberate tail slide; the machine slips backward, but instead of falling to the ground its tail gradually "elevates" and swings the machine, pendulum-like, into a head down position. Pégoud allows this swing to repeat itself several times before he finally brings the machine into its normal line of level flight.

Now, setting aside for the moment the natural curiosity of the crowd in the sensational part of the performance, and in the prodigy of a man who does these things with such *sang froid*, what is its serious or scientific aspect?

Mr. Norbert Chereau, general manager of Blériot monoplanes in England, assures our English contemporary that Pégoud's machine was built as a standard 50-horse-power single-seater in 1911, and that the only alterations made for the purposes of these flights are as follows:

1. A new pylon made 12 inches taller and placed 6 inches farther forward.

2. Substitution of the original tail by one used on a standard tandem-seated model. Neither of these alterations affects the principle of the machine or its "natural stability." It is apparent that the purpose of the taller pylon is to set the top bracing wires to the wings at a less acute angle, and thereby to reduce the stress upon them. "This is a very natural precaution in a machine that flies, so to speak, habitually on its back, and in which the top wires, therefore, so frequently take all the weight of the machine in the air. Ordinarily, the top wires merely support the weight of the wings when the machine is on the ground and their severest stress comes, generally, from a bumpy landing. On Pégoud's Blériot, however, they frequently support the entire weight of the machine in flight."

Similarly, the advanced position of the pylon puts the top front wires in a better position to reinforce the wing against the force of direct resistance.

The tandem model tail is larger than that on the single seater, and gives the greater measure of control that is desirable for extraordinary feats of this description, but not necessarily so for everyday flying.

"We have, therefore, a perfectly normal aeroplane," continues *Flight*, "combined with a perfectly abnormal pilot, and the pilot is abnormal not in performing complicated and rapid movements of the control with the dexterity of a Paderewski, but in having the nerve to sit still in the most trying attitudes while his machine continues properly to carry out the evolution on which he initially caused it to begin.

"If Pégoud got flustered and wiggled his control lever in nervous uncertainty, he would end up in a heap on the ground just as surely as any other pilot does in a similar plight. Pégoud is marvelous because he understands precisely what his machine is going to do, and knows precisely how long he desires it to keep on doing the same thing. In a word, Pégoud is the perfect human automaton.

"Instead of controlling the machine, Pégoud lets the machine control itself. From the standpoint of the scientific experimenter, he is the ideal pilot, for he has the intelligence to eliminate himself at the moment that the machine enters upon its appointed task. He flies it with the utmost skill to the desired altitude, he turns it head downward toward the earth, he drops like a stone with it until he has acquired the momentum necessary to effect his purpose, and then he calmly and deliberately pushes forward his elevator lever and sits still while the machine flattens out on its back.

"The amazing thing is that the man himself can retain his composure in positions that are actually nauseating to the average person. . . .

"The scientific interest in Pégoud's achievements lies in the fact that they are the most complete full-scale demonstrations of the fundamental principles of flight that have ever been carried out. Every aeroplane worthy of the name is inherently stable within certain limits. By this is meant that when an aeroplane is properly designed, it will naturally support itself on a level keel at a certain speed, and will naturally tend to recover that position if the disposition of its surfaces is not tampered with. The control of a modern aeroplane gives the pilot ample scope for destroying the natural stability inherent in the design of a machine, and many an accident is caused through the abuse of the control, the proper use of which is, of course, fundamentally necessary for the purpose of steering the machine on its appointed course."

Ten-day Courses in Agriculture

WINTER institutes for farmers, at which ten-day courses in all kinds of rural subjects are offered, are becoming a regular feature of educational work in Canada. For several years such an institute has been in operation each winter at Truro, Nova Scotia. Last year the attendance at this place numbered about 400, of whom 100 were from Prince Edward Island and a large number from New Brunswick, these two provinces subsidizing all of their inhabitants who wish to attend. Recently Prince Edward Island has established an institute of its own at Charlottetown. The courses offered here include livestock, poultry, horticulture, soil cultivation, seed selection, and dairying; besides women's courses in housekeeping, domestic science, etc. These courses are given free to all inhabitants of the island who care to take advantage of them, and attendance is further encouraged by a bonus of $5, together with free transportation, to anyone who makes prior application and then completes a course satisfactorily. No examinations are held, the pupils being only required to give intelligent interest throughout the lessons; thus the older farmers, as well as the younger, are encouraged to attend. The courses, which are as practical as possible, are given by experts from all parts of Canada.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Humane Animal Trap

To the Editor of the SCIENTIFIC AMERICAN:

I have read with some interest the communication of Mr. George Foster Howell in the SCIENTIFIC AMERICAN of September 13th, 1913, in regard to the cruelty of trapping for wild animals, especially for foxes. I note that Mr. Howell's address is Brooklyn, N. Y., so I suppose he never experienced having his poultry and lambs ravaged by foxes. I have had opportunity to observe Mr. Fox's cruelty to his victims. When a boy the first living fox I ever saw had a live chicken in his mouth. I scared the fox; he dropped the chicken, which was not dead, but lacerated and wounded to the death. I have seen turkeys where foxes had eaten a portion of their bodies and left them to die in pain. The article referred to reminds me of the fable in Æsop where the wolf criticizes the men for slaughtering the lamb. It is well enough to hear both sides. If the Massachusetts Society for the Prevention of Cruelty to Animals will get some Prof. Garner to teach them fox talk and instruct sly Reynard to carry firearms for his victims, they might prevent more cruelty than by improving traps.

Woodbury, Tenn. W. R. SMITH.

[Our correspondent misses the point, we fear. His is the "eye for an eye, a tooth for a tooth" doctrine. Because foxes are cruel (what animal is not?) that is no reason why man's traps should inflict pain.—EDITOR.]

Is Engineering an Exact Science?

To the Editor of the SCIENTIFIC AMERICAN:

Having read all the matter that has been available to me, I write to ask you if no attempt has ever been made to stablize the hills that have been sliding into the Panama Canal prism. Piers in a river supporting long spans often form an ice gorge, and they are constructed in such a way as to offer the least possible opportunity for a collection of ice. It seems to the writer that some means by which the earth could be halted and held is far from an impossibility.

That much money has been spent for surveys and boring on the route of the canal is well known, and *I would like your opinion of engineering as an exact science* when it was estimated after exhaustive work that the Culebra cut banks would stand at an angle of about 33 degrees from horizontal, and that in practice they are still moving and at an angle of about 7 degrees.

Cowles, Neb. F. A. GOOD.

[The slides at Panama do not vitiate the claim of engineering to be an exact science. We doubt if even more expensive borings would have revealed the fact that the Culebra material was so unstable as to require a slope of 1:7—which could be demonstrated only when the cut was fully opened. Engineering is "exact," if the conditions can be foreknown.—EDITOR.]

Reversing the Locomotive

To the Editor of the SCIENTIFIC AMERICAN:

If it is not prolonging the discussion on "Reversing the Locomotive" beyond the point justified by its importance to your readers, I would like to add these few comments.

The correspondent in his letter on this subject in the issue of September 20th has very clearly explained how it is possible to retard a moving locomotive with only the use of the reverse lever and throttle. That the above is possible is obvious to anyone who intelligently considers the matter, and that it was possible was not denied in my letter printed in issue of July 5th; your correspondent to the contrary, notwithstanding. I had misinterpreted your editorial comment of June 21st to advocate an automatic stop which would utilize only the reversing power for retardation, and pointed out the uselessness of such a device.

As to the question of the engineer relying upon the retardation from the reversing power, if he must first prove to himself that the air-brakes are inoperative; then close the throttle, then throw over the reverse lever; and then "gage the steam so that he will get very nearly" the ultimate tractive power for retardation, he would by this time have gone down, in most real emergencies, as a martyr to duty. In the case of the wreck at Stamford on June 12th the engineer probably would have had less than 15 seconds to complete the four above operations.

It is certainly absurd to advocate makeshift practices which were used in connection with locomotives before they were equipped with air-brakes to be applied to locomotives equipped with the modern reliable air equipment. As pointed out in the editorial comments on this subject in the issue of July 5th, when all other means have failed in retarding the train, reversing the power should be used as a last resort, just as a drowning man would grasp for a straw, and should never be relied upon when there is the slightest possibility that the air brakes are operative, which is not as easy to determine, quickly, in the moment of mental stress as it might be supposed. At present it seems to me to be only a remote possibility that such a principle could be incorporated in an automatic stop device.

I wish to thank you for having allowed me the valuable space in your paper for my previous communication. W. L. HEINZ.

Sailing Hydroplanes

To the Editor of the SCIENTIFIC AMERICAN:

I have noticed with interest the development in the last few years of the motor-driven hydroplane, but I have seen nothing of any sail-driven hydroplanes. I am sure that if a cup defender is desired that will run away from anything else driven by the wind, a sail-driven hydroplane is what is wanted.

About fifteen years ago my brothers and I used to sail boat races on the ponds. It was too much trouble to make a hollow-hulled boat, so we fashioned ours by taking a piece of lath, setting it up edgewise, fastening a piece of shingle across one end, sloping upward forward at an angle of about 25 degrees, then fastening a cross-bar to a short mast which was stepped in the upper edge of the lath near the front end, the end which bears the piece of shingle mentioned; to each end of this cross-bar was fastened another piece of shingle sloping upward forward at the same angle as the first. This was the hull of the boat. We stepped the mast in the edge of the lath just behind the cross-bar, attached a long rudder to the rear end, and when the sail was up the "boat" was ready to go. You can see that we had a rough hydroplane with outriggers. When the "boat" sat quietly on the water it was barely afloat, but as soon as the sail began to draw it began to rise, and as soon as it had got clear of the water it was "flying." These boats attained surprising speed.

I would like to know if any of your correspondents have ever tried this form of craft. If not, I would like someone who lives at the seashore to try it and let me know what are the results. ERNEST WELTMER.

Nevada, Mo.

Is the Dunne Machine Inherently or Automatically Stable?

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of August 23rd, page 139, under Aeronautics, I see that a flight across the Channel has been made in Dunne's self-balancing aeroplane.

To this aeroplane is attributed *automatic* stability, while it is only *inherent* stability, which is not sufficient under *all* circumstances.

The difference between automatic and inherent stability may be seen in my article in the SCIENTIFIC AMERICAN of December 17th, 1910: "Distinction to be made between inherent and automatic stability of aeroplanes." It is said that Dunne's machine is shaped like a letter V and has no tail. I call attention to the article "A New Aeroplane" in the SCIENTIFIC AMERICAN SUPPLEMENT 1682 of March 28th, 1908, where my *arrow* shaped aeroplane shaped like a letter V and without a tail is *shown*. Likewise such aeroplane, *arrow* shaped and with supporting surfaces, shaped like a letter V (diedral angle) is already shown in my United States Patent 710,266, of September 30th, 1902. Figs. 3, 4, and 5. In the book: "Progress in Flying Machines," by O. Chanute, C. E. printed 1899, already on about 19 pages the "Diedral Angle" is mentioned, but it remained for other inventors to *bring order* out of *chaos* and point out the *essential* parts.

That I antedate and have the priority over Dunne, Fokker, Lohner and many others, is proven by my patent drawings of 1902, and by my article in the SCIENTIFIC AMERICAN SUPPLEMENT, 1682, of March 28, 1908.

With my aeroplane no further experiments could be made for lack of funds, and likewise other now very much needed experiments concerning automatic balance propulsion, etc., cannot be made, for the same reason, respectively because there is no experimental station in America, where inventors can get their inventions tried out, without cost to the inventor, who, as a rule, has not sufficient funds for that purpose.

Clarksville, Tenn. THEO. GIBON.

The Stratosphere

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the last lines of your notice on page 159 (August 30th last) to my paper read at the R. Met. S. on Air Currents at fifty miles: "These conclusions hardly agree with the prevailing conception of the stratosphere as a region of gentle wind," I may point out that we have no authority for stretching the stratosphere beyond the limits explored, say up to 15 miles or possibly a little more.

The velocities at fifty miles are quite in agreement with previous records of meteoric trains, but rarely if ever before have such complete records been available by which such definite results could be obtained. These results have been confirmed by the great authority on meteoric science, Mr. W. F. Denning, of Bristol, working to a large extent on independent data.

J. EDMUND CLARK.

[Whether the stratosphere extends up to fifty miles is mainly a question of terms. Dr. Alfred Wegener has recently introduced the idea of a "hydrogensphere" beginning at about that altitude, and of another "sphere"—the "geocoroniumsphere"—very much higher; but most meteorologists still think of the atmosphere as divided into two main strata—the troposphere and the stratosphere, or isothermal layer. We did not intend to question the accuracy of Mr. Clark's observations—which are in accord with those that have been collected and discussed for several years past by Dr. C. C. Trowbridge in this country—but to point out the contrast that certainly exists between all these meteor train observations and an idea that seems to have crystallized in recent meteorological literature; viz., that the whole upper atmosphere is a region of gentle winds. A marked falling-off of wind velocity in passing from troposphere to stratosphere is regularly shown in aerological observations, notwithstanding the great horizontal contrasts of temperature that exists within the stratosphere at all levels that have been sounded. Whether there are theoretical reasons to expect stronger winds at high levels—and whether it is not a mistake to insist upon the "non-convectional" character of the stratosphere—are questions that well merit the attention of students of atmospheric physics.—EDITOR.]

Rearrangement of Star Maps

To the Editor of the SCIENTIFIC AMERICAN:

I noticed in your columns for printing the personal letters of correspondents upon different subjects a letter recently which had to do with the prevalence of error in our American geographical maps or charts.

Why can we not take up the matter of the errors in our allegorical star charts of to-day? The allegorical star charts of to-day are covered with a system of figures, and hardly any of them agree as to the proper placing of such figures. Very little is known as to the origin of those which do exist upon our maps, and further they are apparently placed at random in most cases.

We have sufficient evidence in hand now to enable us to place these figures very accurately or arbitrarily. At least such can be done with the most vital figures of the northern heavens proper. The original outlines in each case are practically speaking eternal in so far as man's period of existence on the earth is concerned. Each figure should be tied to the starry outlines constituting such figure in a rigid manner.

A great number of the inhabitants of the celestial vault do not belong there at all. On the other hand, many of them are placed in a position foreign to that which they should occupy. In a great many cases they lie entirely outside of the territory which they should cover.

In a word, we need a new survey of the sky very badly. Our star charts are very obsolete in this respect. Can we not get our astronomical machinery busy upon the job and make a more up-to-date or rather back-to-date set of charts.

The Great Bear or Ursa Major will lose to the Lion and Bull of course. In fact, he will lose out entirely. Cepheus will be seated upon his throne and adjusted to the proper position and proportions for the first time in some thousands of years. Andromeda and Prometheus will be rivals for the possession of the huge human figure which overspreads the galaxy from the region of Lacerta to Ophiuchus, or a distance of some two thirds way across the visible sky.

Off in the southern heavens we shall have to undertake a general overhauling and must of necessity "paint that part of the town red." Here we shall have to resurrect the menagerie or circus of animal forms which belong there by divine right, dethroning a number of usurping inhabitants who are undoubtedly aliens in that locality. The monkey or ape tribe predominate in the region of Pegasus and Aquarius and are very naturalistic and real in form and proportions. The three monkeys in southern Aquarius are very life-like little fellows and seem very intent upon their business, whatever that may be. The head in conjunction with the lower fish of Pisces approximates very closely to that of a dog, still it is not difficult to see how the Egyptian could have made of it the sacred dog-eared ape representative of Thot. It is also very apparent that it has been seen as guarding the entrance to the ill-reputed place of this locality of the heavens.

We have the major figures of the northern heavens proper very accurately determined now. Why not start a revolution to oust the many aliens and usurpers as well as to readjust the native inhabitants to their proper spheres? The data are self-evident truths, once our attention is called to the different forms.

Pueblo, Colo. LEE H. MCCOY.

Earthquakes and the Panama Canal

A Study of the Geological Conditions on the Isthmus and What it Reveals

By Donald F. MacDonald
Geologist Isthmian Canal Commission

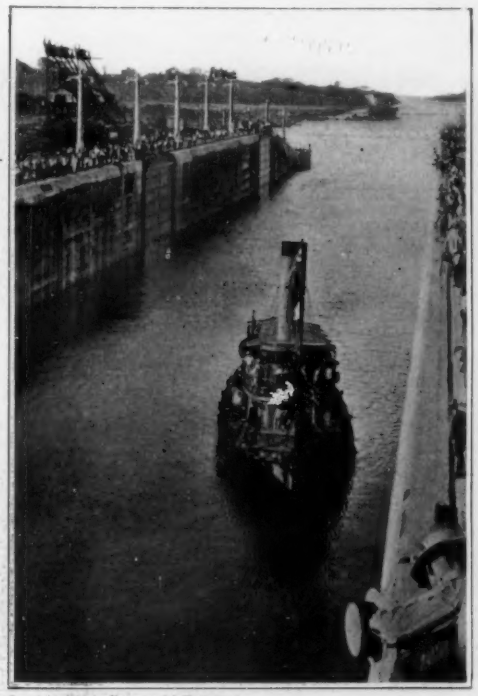
THE earthquake belts of Central and South America are approximately coextensive with the regions of fairly high mountains. Within the Republic of Panama there are few, if any, mountain ranges, properly so-called; but there are high mountain groups. The older geographies informed us that the North and South American Cordilleras were practically one continuous chain from Alaska to Cape Horn. This is quite incorrect, for the mountains of Panama, Costa Rica, and some of the other Central American republics are younger than are the great ranges of the western States, and are units quite distinct geographically from the greater northern and southern continental ranges. Furthermore, they have had a different origin, for they are not due to folding by lateral pressure, as the mountains of western America chiefly are, but originated from intrusions of volcanic rocks, as necks, cores, masses (Fig. 1) and irregular dikes (Figs. 2 and 3). These intrusive rocks are of five broad types, which, given in the order of their importance, are: basalts, diorites, andesites, granodiorites, and some rhyolite. In their original molten condition, they were injected up through volcanic agglomerates, breccias, and tuffs; and sandstones, argillites (Figs. 2 and 3), limestones, and soft shale beds, mostly of Oligocene age. Most of the bedded rocks cut by these bodies of igneous, or volcanic rock, are not very well consolidated, except in the vicinity of the higher mountains. There they have undergone some induration and slight baking, due to the great masses of formerly hot lava rock which was injected into them. The basalt, and esite, and rhyolite intrusions are mostly post-Oligocene, and seem to be largely Miocene in age. The diorite is, at least in part, pre-Oligocene, probably of Eocene time. The fact that the earthquakes are coextensive with these mountain groups is evidence that the latter, at least locally, have been pushed up beyond the stability of their foundations, and are even yet slowly settling back to adjustment. Both Gold and Contractors' Hills are, on a small scale, such settled down masses, as will be explained later. There are only two peaks within the Canal Zone that reach up to elevations of approximately 1,000 feet, and there are no peaks within thirty miles of the canal that are higher than 2,000 feet. Not within one hundred miles could one find mountains over 4,000 feet in elevation. Therefore, the canal is far removed from the great mountain masses, the settling and adjustment of which might cause cumulative stresses, that would culminate in rock ruptures great enough to give destructive earth vibrations. Furthermore, the relative weakness of most of the rocks within the Canal Zone region, prohibits the accumulation of stresses sufficiently great to cause violent rock rupture, with concomitant earth jars of destructive proportions. Theoretically, then, we would expect the Canal Zone to be well outside the Central American earthquake belt. This is quite in accordance with the facts of observation as given in a long and fairly complete record[1] of the quakes that have occurred from the time of the Spanish conquest to the year 1886.

The Earthquake Record of Panama.

In all that time and up to the present only two severe shocks were noted; one of these, in 1621, destroyed many of the buildings in Panama, and one in 1882 damaged several buildings and bridges, and locally threw the railway track out of alignment. In Colon the latter quake is said to have opened a few crevices, and to have been attended with some fatalities. Very many smaller shocks have occurred, and since the installation of seismographs by the Isthmian Canal Commission, numerous tremors, most of which are detectable only by instrument, are recorded every month. The liability of the canal to injury and destruction by earthquakes has been proclaimed; but the fact is that no earthquake since 1621 would have inconvenienced it, and the shock of that year, though severe enough to shake down adobe houses, and even some masonry structures, would have had no serious effect on canal slopes, and little effect on such rock founded, solid concrete structures as the locks.

It is interesting to note the difference between earth tremors caused by a heavy blast and those due to earthquakes. This difference is clearly registered in the different effect which each produces on the seismograph. The instrument at Ancon is a 100 kilogramme, Bosch-Amori, which magnifies earth waves ten times.

[1] "Tremblements de Terre et Eruptions Volcaniques au Centre-Amerique, par F. de Montessus de Ballore, p. 61, Société des Sciences Naturelles de Saone-et-Loire, Dijon, 1888."



Copyright, 1913, by Underwood & Underwood.

First vessel through the Gatun locks.
The tug boat "Gatun" passing from the Atlantic Ocean to Gatun Lake.

The recent occurrence of two earthquake shocks at Panama renders timely the following article by the geologist of the Isthmian Canal Commission. Although the shocks were sufficient to alarm the native laborers from the West Indies, used as they are to such tremors, Colonel Goethals reports that not the slightest injury was done to the canal. This proof of the stability of the works came a day or two after the first passage of the Gatun locks by a vessel, as shown in our historic illustration.—EDITOR.

Ancon Quarry has been the theater of considerable heavy blasting. It is 3,100 feet S. 61 deg. W. from the instrument. Some of the blasts there, and their results, are as follows:

1. April 8th, at 5:25 P. M., 10,700 pounds of dynamite exploded, recording stencils swung 20 millimeters north and 9 millimeters south, 75 millimeters east and off the paper, thus giving no back swing to the west.

2. March 2nd, 12:30 P. M., 6,000 pounds of dynamite gave a vibration record of 6 millimeters north and 1 millimeter south, 11 millimeters east and 5 millimeters west.

3. June 2nd, at 5:10 P. M., 4,000 pounds of dynamite swung the stencils 11 millimeters north, 2 millimeters south, 5 millimeters east, 2 millimeters west.

4. April 30th, 5:15 P. M., 1,200 pounds of dynamite caused the stencils to swing only ½ millimeter on each side of both lines.

5. On March 29th, 1,000 pounds of dynamite showed no north-south, and only 1 millimeter of east-west motion.

Two subaqueous blasts were set off in the canal close to station 2,200. These were 10,350 feet due west of the seismograph station. The first, on March 17th, at 10 A. M., was an explosion of 17,155 pounds of dynamite. It registered 1 millimeter of north-south, and about the same of east-west motion. The other was a blast of 10,350 pounds of dynamite set off at 10:15 A. M., April 30th. This showed an east-west motion of 2 millimeters and a north-south one of 4 millimeters about equal on each side of the trace lines.

In the larger blasts at Ancon Quarry the violent push given to the rocks by the explosion threw the recording stencils over toward the east and north, with a very small swing back to the opposite directions. The motion was accomplished with not more than two, and mostly one, quick strokes, occupying 2 to 3 seconds of time. After that the vibrations were very minute and much slower, and died out entirely in 10 to 15 seconds. In the smaller blasts the distance was great enough to cushion completely the first violent impulse given to the rocks, because the swing of the recording stencils to each side of the lines was equal. In the case of the subaqueous blasts the distance was also great enough to cushion the first violence of the shocks.

A Study of Some Blasting Effects.

Some other blasting effects near Culebra were recorded on less sensitive instruments, and these, translated into approximately the terms of the standard instrument at Ancon and Gatun, are as follows: Fourteen 24 and 28-foot holes, loaded with 2,250 pounds of dynamite, were exploded within 1,100 feet of the instrument, and gave a maximum amplitude equivalent to 20 millimeters. Therefore an increase of almost 139 per cent in the dynamite charge, gave an increase in the recorded effect of only 40 per cent. Both of these blasts were in comparatively soft argillaceous rock, and were situated almost 30 feet below the top of a 200-foot cut slope. This location, so close to the edge of a high, steep slope, would, of course, increase the tendency to vibrate. In general, it may be said that a blast of 5,000 pounds of 60 per cent dynamite would not register on the standard Ancon instrument at a distance of more than 2½ miles, under the local geological conditions. In summary, then, it may be said that the earth vibrations, generated by blasts, are distinctly different from those set up by earthquakes. Blast vibrations are comparatively rapid and apparently almost wholly compressional. They consist, in quite limited degree, of large, slower waves or movements and smaller, rapid vibrations. Earthquake tremors, on the other hand, are slower and more undulatory, but they, too, record major undulatory motion, or impulses, together with minor oscillations. The chief reasons for this difference probably are:

a. Blasts are near the surface where the rocks are under slight pressure, and, therefore, more elastic.

b. Earthquakes are relatively much more deep-seated and are generated where the rocks are under stresses which greatly reduce their elasticity.

c. Blasts are quick acting shocks like the blow of a hammer.

d. Earthquakes result from slower acting rock ruptures.

In addition to earth waves, blasting also generates atmospheric waves, or compressions, which travel with the same velocity as sound, because the atmospheric jar and the sound from the blast always arrive simultaneously. The earth waves from the blasts travel much more rapidly than sound. The deeper the blast, other things being equal, the greater the proportion of its energy goes into earth waves and the less into atmospheric waves. The latter often jar houses more than do the earth waves, and for this reason it was for a time held by some that the "dobe" or surface blasting tended, more than deep blasting, to promote slides in Culebra cut. Such, however, is the opposite of the fact.

Exposed in the walls of Culebra cut are sections of two large volcanic cores, the Gold Hill mass and the Contractors' Hill mass. Both of these have been faulted down (Fig. 1) some hundreds of feet through the surrounding softer sedimentary rocks. The sheared zone around the margin of each is from 2 to 10 feet wide, and the downward drag of the Gold Hill mass has pulled small masses of lava down over 100 feet from a former flow. This is all exposed in the face of the cut as shown in Fig. 5. Such a frictional pull, coupled with such a wide sheared zone, indicates a down throw of at least 300 feet, and perhaps much more. Gold Hill rises to over 600 feet above sea-level, and has an approximate area of 1,500,000 square feet. If we call its depth 1,000 feet we have a mass which weighs approximately 112,500,000 tons. This mass has been faulted down at least 300 feet, but to accomplish this probably required a considerable period of time. If, for the sake of comparison, we assume that it dropped freely one foot only, we find that by such a drop it would exert a total pressure on its base, or strike with a kinetic energy of 225,000,000 tons. Now, P. Gerald Sanford ("Nitro-Explosives," page 286) records that one kilogramme of pure nitroglycerine on explosion exerts a pressure of 19,151 kilogrammes, therefore a blast of 18,000 pounds of 60 per cent dynamite, equivalent to 10,800 pounds of nitroglycerine, would exert a pressure of 106,831 tons, only about 1/2,106th part of the pressure developed by the down drop of Gold Hill one foot. Broadly speaking,

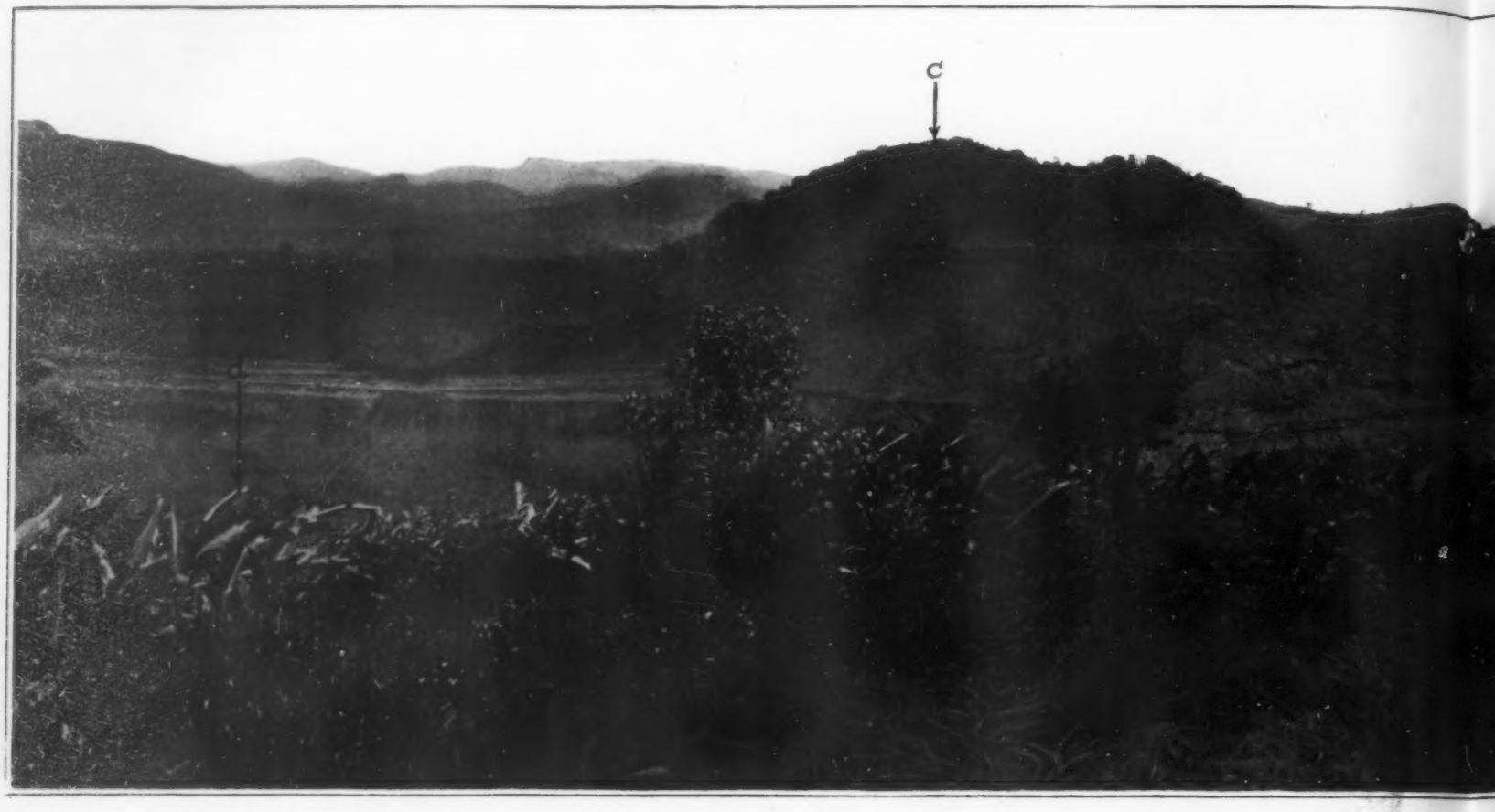


Fig. 1.—Panoramic view looking southward

(*a*) Ancon Hill, Panama (elevation, 660 feet). (*b*) Contractors' Hill (elevation, 425 feet). (*c*) Gold Hill (elevation, 662 feet). (*d*) Culebra Cut. Nearly all the hills shown in this figure are mas so-called continental divide. It will therefore be seen that this divide is not a well marked ridge, mu

such a little slip of this very small mountain, or large hill, would cause an earthquake equivalent to the explosion at say 1,000 feet below the surface of about 18,954 tons of dynamite. This would be about fifteen times as great as the largest artificial explosion so far known in the history of the world. No wonder then that adjustment of earth blocks are dangerous to human activities.

Though not absolutely impossible that a destructive earthquake might visit the canal, still it is so extremely improbable as to be well outside the range of all practical considerations. In summary then, the following are the chief reasons why it is believed the canal will never be in any appreciable danger from earthquakes:

Conclusions to be Reached.

1. The large number of tremors instrumentally recorded every month is evidence that slow adjustments are constantly taking place, and thus no great accumulations of stress, that might later culminate in a big shock, are possible.

2. The absence from the Isthmian region of high mountains and of geologically recent volcanic activity is evidence in favor of the absence of earthquakes; especially, as such high mountains are a striking geological feature of the whole Central American earthquake belt.

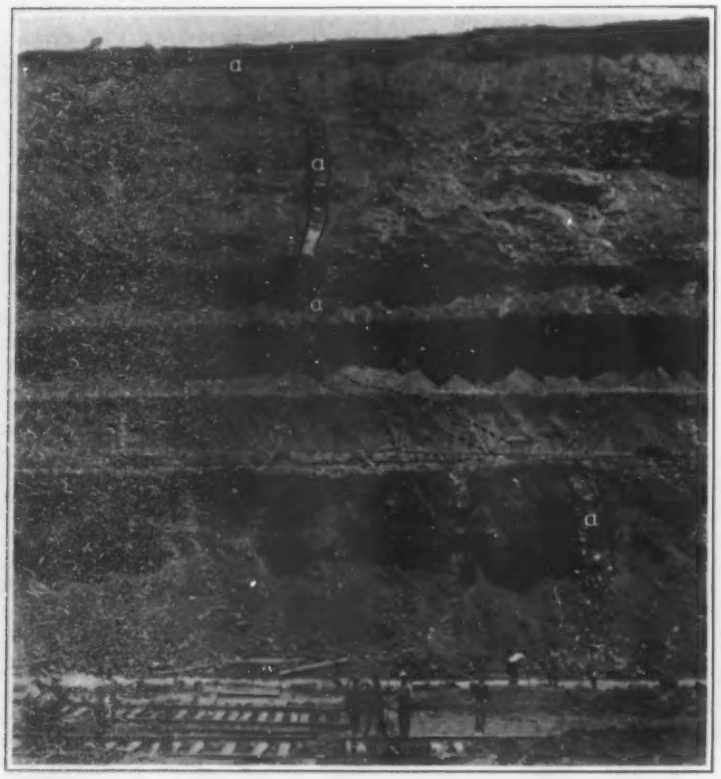
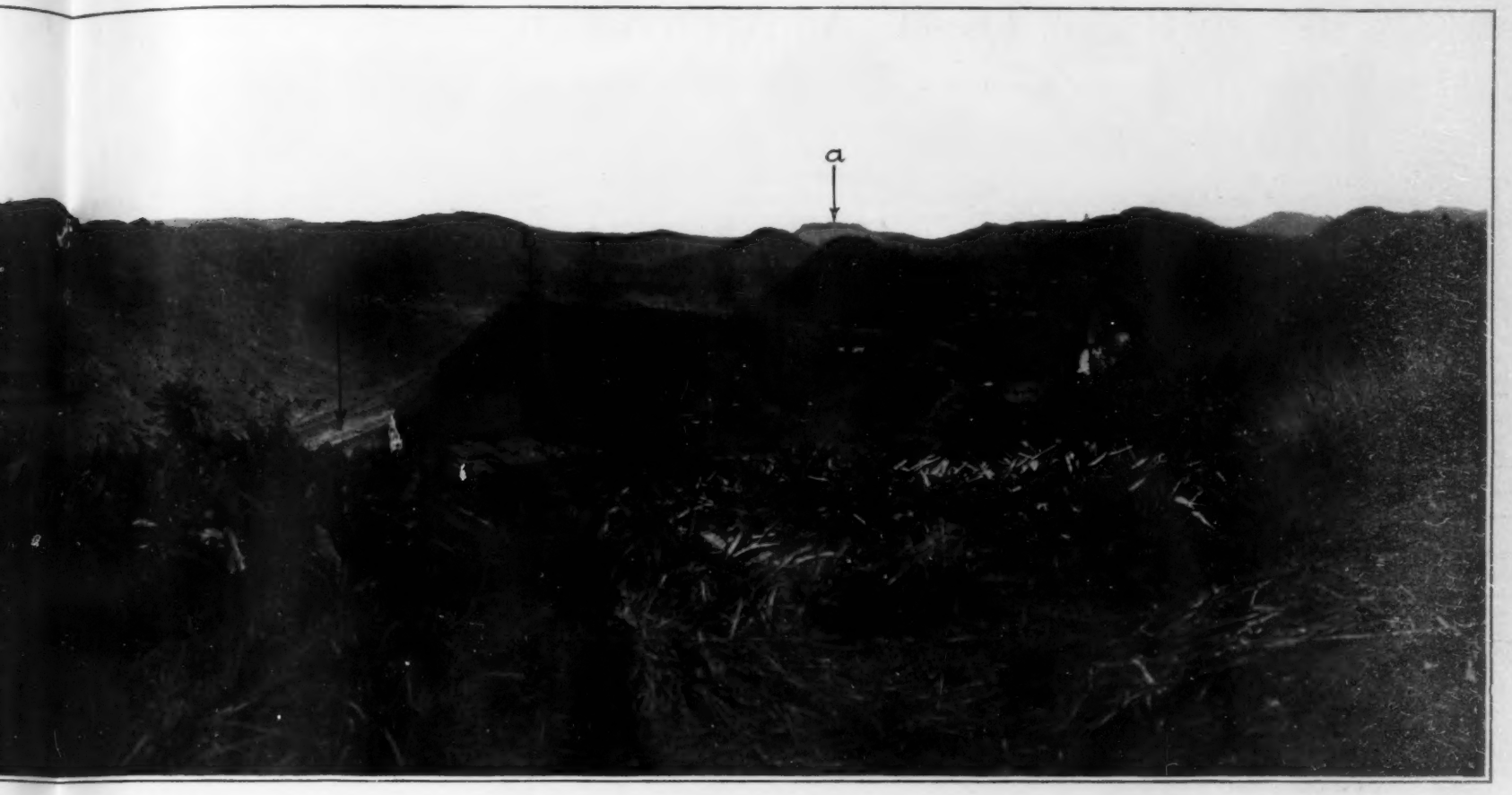


Fig. 2.—A dike of basalt (a), which cuts volcanic clay rock; Culebra Cut, near Culebra.

This basalt was hot molten lava when it was injected into the clay rock. Since cooling it has been subjected to shearing stresses which have broken and jogged it considerably. The parallel benches mark the levels of the excavation tracks. The intrusion of volcanic rocks, as necks, cores, masses and irregular dikes, shows that the mountains of Central America had a different origin from the ranges of our western States. In other words, they are younger than the Rockies, and it is consequently incorrect to suppose that the chain of peaks extending from Alaska to Cape Horn is continuous geologically as well as geographically.

Fig. 3.—(a) Close view of a basalt dike about five feet wide, which cuts volcanic clay rock.

This cut illustrates a geologic action similar to that shown in Fig. 2. The difference in the materials is very marked and the lines of demarcation are sharply drawn. Most of the bedded rocks cut by these bodies of igneous or volcanic rock are not very well consolidated, except in the vicinity of the higher mountains. The intrinsic rocks are of five broad types, which, given in the order of their importance, are: basalts, diorites, andesites, granodiorites and some rhyolite. In their original molten condition they were injected up through volcanic agglomerates, breccias, and tuffs; and sandstones, argillates, limestones, and soft shale beds, mostly of Oligocene age. While all this indicates past volcanic activity, there is no reason for imagining that the canal is in danger.



g southward and eastward from Zion Hill, Culebra.

figure are masses or cores of hard volcanic rock. The softer rock between these hard masses has been worn away by stream erosion to the form of the present valleys. Gold and Contractors' Hills are in the rked ridge, much less a mountain range, but is composed of a group of steep, irregular, individual hills.

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3. The presence of numerous small faults and of the faulted down conditions of such volcanic cores as Gold Hill and Contractors' Hill is evidence that adjustment here has progressed well on toward the establishment of normal conditions of equilibrium.

4. The tensile strength of the majority of the rocks within the Canal Zone is quite low, and they would shear with comparative ease, thus preventing any relatively great accumulation of stress which might result in a comparatively intense shock. However, experience teaches that where earthquakes happen, maximum destructive effects on buildings occur where they are built on loose and friable material. This consideration might therefore subtract a little from the saving benefits of the yielding and preventive qualities of the Canal Zone rocks.

5. Over three hundred years of earthquake observation shows only two shocks of considerable magnitude, and there is every reason to believe that the severest of these would not have seriously damaged even the most delicate parts of the canal.

That many small and harmless shocks will traverse the Canal Zone is certain, but that the canal is liable to be seriously damaged by earthquakes is contrary to all the evidence.

Fig. 4.—Shows sections of east side of Culebra Cut, north edge of Gold Hill.

(*a*) Large basalt dike which forms the northern margin of the Gold Hill mass. (*b*) Volcanic clay rock of Oligocene age. (*c*) Fault plane. The Gold Hill mass settled down through the volcanic clay rock (*b*) after having originally come up through it. (*d*) Lava flow, covered by slide material near fault plane. (*e*) Large piece of lava flow broken off from (*d*) and dragged downward over 100 feet to present position, by frictional pull of the settling mass of Gold Hill. This settling, or faulting downward, of Gold Hill, and of Contractors' Hill, occurred many thousands of years ago.

Fig. 5.—A very remarkable fault plane (c) on the west side of the Culebra Cut, just south of Las Cascadas.

The earth adjustments which caused this, and similar breaks or faults, took place thousands of years ago. The rocks on the right of (*c*) dropped downward about forty-five feet, as shown by the fact that (*a'*) is a continuation of the lava flow (*a*), (*b'*) of (*b*) and so on. A minor break or fault plane is shown at (*d*). The relative weakness of most of the rocks within the Canal Zone region prohibits the accumulation of stresses sufficiently great to cause violent rock rupture, with concomitant earth jars of destructive proportions. Theoretically we should expect the Canal Zone to be well outside the Central American earthquake belt. This is quite in accordance with the facts of observation as given in a long and fairly complete record of the quakes that have occurred in the past. There is no reason to suppose that the works at Panama will ever be totally destroyed by a severe earthquake.

Rudolf Diesel: An Appreciation

The Significance of a Great Inventor's Work

By Henry Harrison Suplee

THERE are inventors and inventors!

The old-time idea of an inventor was a man who, suddenly, in some occult manner, conceived the idea of something new, wonderful, and valuable, and who then spent the rest of his life trying to get capitalists interested in it; a man who was lucky if he did not die poor and enrich others after he was gone.

The modern inventor is something quite otherwise; a trained engineer, who, perceiving the defect in some department of engineering work, directs his mind to the solution of the problem, and, bringing to it ample theoretical knowledge, carefully and accurately works out practically the application of the theory to definite success. Such modern invention is typified by the work of Rudolf Diesel.

In the summer of 1897, the *Verein deutscher Ingenieure* was holding its convention at Cassel. During the meeting the members of this important engineering society were invited to witness the operation of a new type of heat motor, the result of the application of modern thermodynamic principles to the problem of securing maximum efficiency in the development of mechanical energy from the combustion of liquid fuel. That motor was the Diesel engine. As then shown and enthusiastically admired it was practically the same as that which is now known all over the world as the most efficient heat motor in existence, and the greatest advance in the generation of power from heat since the invention of the separate condenser by Watt.

Rudolf Diesel, born in Paris in 1858 of Bavarian parents, received his early education in the French capital, and thus acquired the easy fluency in the French language which made him so acceptable a speaker before the meetings of the *Société des Ingénieurs Civils de France*. The outbreak of the war in 1870 rendered it necessary for his parents to leave France, and a portion of the time after this was spent in England, so that, to a thorough knowledge of German and French, there was added an equally great proficiency in English, rendering the young man a true cosmopolitan in training and thought. A course in mechanical engineering at the Münich Polytechnic, under such masters as Schröter, in mechanics, and von Linde, in thermodynamics, was followed by an excellent business training in charge of the Linde refrigerating machine interests in Paris. Thus there were brought to the attention of this acute and broad intelligence the fundamental problems in the relations between thermal and mechanical energy in connection with gases under high pressure. The first result of this combination of theoretical and practical ideas to be given to the public was a small book entitled "The Theory and Construction of a Rational Heat Motor," this appearing in 1893. Here we see the scientific man, working mentally to consider the necessary elements of a rational machine for converting heat into work. He approached the subject along the lines of his master, von Linde, considering the various cycles possible, and selecting the so-called Carnot cycle as offering the possibility theoretically considered, of attaining the maximum thermal efficiency. Having chosen the cycle, the best methods of attaining it were considered, and with these came also the knowledge of the importance of operating with a high compression ratio in connection with high efficiency.

These things determined, there followed a study of the best practical approximations which might be expected to these theoretical conditions.

We see here a complete reversal of the older ideas of inventors, of those men who, having conceived some kind of a machine, proceed to try it out experimentally, and after many failures, succeed in hitting upon something which will work, and which may, after many discouraging experiences, be developed into successful operation. The motor of Diesel, on the contrary, was first worked out wholly on paper, as a *rational* application of theoretical principles, and then and not until then, was a machine built. At this time the best thermal efficiency of the steam engine, and that in large units, was about 15 per cent. The early Diesel engines of small size, 20 to 30 horse-power, showed immediately an efficiency of more than 30 per cent; and the thermal efficiency, or percentage of total heat value in the fuel converted into power in the cylinder, in present Diesel engines is from 42 to 48 per cent, or nearly three times the efficiency of the steam engine, and double that of the ordinary gas engine. Even when the frictional losses in the mechanism of the machine are deducted, the actual efficiency in the power available for useful work has reached about 35 per cent, and this because of the scientific application of theoretical principles to the design of a rational heat motor.

Copyright, 1912, by Edwin Levick.

Dr. Rudolf Diesel, the inventor of the Diesel engine.

Apart from the adoption of an efficient cycle, and the use of high compression ratios, the Diesel engine has accomplished an important commercial result in two ways: the heat of the compression is sufficient to ignite the fuel charge directly in the cylinder, thus eliminating altogether the carbureter, that source of so many annoyances in ordinary combustion engines; while the absence of any ignitable charge during the compression stroke renders back-firing impossible.

The intimate admixture of the pulverized liquid fuel, into the midst of highly compressed air much above the temperature of ignition, also insures complete combustion, even when heavy and ordinarily difficult fuels are used, so that all liquid fuels may be used indifferently, from the light gasoline to the heavy distillate residues. Gas tar is readily and fully consumed, and vegetable oils, such as peanut oil or castor oil, are freely converted into power in the Diesel engine. The revolution which such a machine is creating in the development of power must appear. In nearly all the countries of the civilized world the Diesel engine is being manufactured, and the leading constructors of Germany, France, Switzerland, Russia, and Sweden, as well as England and America, are interested in this modern power machine. It propels practically all the effective submarine vessels in service, it is entering into the merchant marine, and unless the ship on the water is superseded by the ship in the air, it must enter the naval service of all progressive powers.

The contrast between this modern method of producing power from fuel with the older machine, the steam engine, is interesting. Instead of burning fuel inefficiently under a boiler, to convert water inefficiently into steam, conveyed inefficiently through a pipe, to be expanded inefficiently in a cylinder, the fuel is injected as a spray into a mass of dense, highly heated air, in the very cylinder where the power is to be generated. Closely crowded into contact with ample air for its complete combustion, the fuel is completely burned to the gaseous state, without any residue, pushing the piston before it to make room for its increasing volume and that of the expanding air which it is heating, but without increase in pressure. Then, expanding along an adiabatic curve, it yields up energy which, in the cruder machine, was largely dissipated uselessly, and, like an expanded spring, is released.

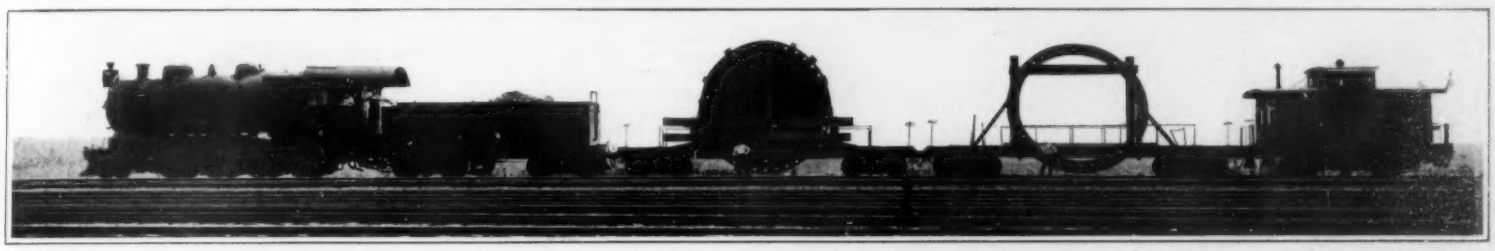
There is probably no more laborious and exhausting work demanded of human beings than that required in the stokehold of a great steamer; and no more impressive demonstration of the result of the work of Rudolf Diesel can be given than to compare the infernos before the furnaces of a marine boiler with the cleanly, cool, and silent engine room of such a vessel as the "Selandia" with its Diesel engines.

In the University of Glasgow there is cherished the model of the Newcomen engine upon which James Watt was working when he conceived the idea of the separate condenser. In the museum at South Kensington there are some fragments of Stephenson's "Rocket." There is cause for gratification that in the new buildings of the great German Museum at Münich, the original Diesel engine is preserved as a monument of the result of the union of theory and practice.

A Hydro-aeroplane Flight From Newport to New York

ON September 29th William Thaw of Pittsburgh and Gleason Macgordon started from Newport in a Curtiss flying boat. They landed on Oakwood Beach, Staten Island, on October 6th. The most eventful portion of the trip was the journey from Morris Cove, Conn., to Staten Island. In flying down the East River the aviators had to pass under three bridges, which they did with ease. Indeed, the bridges gave them less concern than the smoke and cinders in the atmosphere of New York. This is one of the longest hydro-aeroplane journeys thus far made in the United States.

An Official Register of Selected Plants will shortly be established in Hungary, if the recommendations of E. Grabner, director of the Royal Hungarian Institute of Plant Selection at Magyarovar, are accepted by the government. The objects of this register will be, on the one hand, to protect the rights of plant-breeders and prohibit the illegal sale of varieties improved by them, and, on the other, to afford every guarantee to the purchaser of the strict selection of the variety which has produced the seeds he wishes to buy. This guarantee will not extend to the quality of the seeds (e. g., their power of germination), nor to the value of the crop, but merely to the identity and purity of the variety. Detailed plans for this undertaking have been submitted to the Ministry of Agriculture, including provision for the inspection of the plants that it is desired to register, specifications to be employed in the records, registration fees, test sowings of the registered plants to be made by the Institute, etc.



Special train transporting the 46-ton cover plate and 9½-ton curb plate.

Note how the huge castings tower above the locomotive and caboose.

Transporting a 46-Ton Cover Plate

A Railroad Bed Lowered to Accommodate the Castings

THE great aqueduct siphon which passes 1,114 feet below the Hudson River is to have its shaft at the west bank closed with an enormous concrete plug, but it is essential that the shaft at the east side be provided with a removable cover so that access may be had to the tunnel when required. Those who have read the article in the SCIENTIFIC AMERICAN of June 24th, 1911, will recall that the aqueduct comes down to the Hudson River from a considerable elevation, so that a heavy head of water must be contended with even at the very top of the east shaft, and it has been necessary to design a closure of this shaft which would withstand an enormous upward thrust.

The shaft is 14 feet in diameter. In the concrete lining, 46 feet below the top of the shaft, an anchor ring is embedded. This ring holds the heads of 36 anchor bolts, each 4½ inches in diameter and 50 feet long, made of nickel-chrome steel. These bolts pass through a ring at the top of the shaft known as the "curb ring" and through bolt holes in the dome-shaped cover that fits upon the curb ring. To make a perfectly tight joint between the curb ring and the cover, lead wool calking and a special rubber gasket are employed.

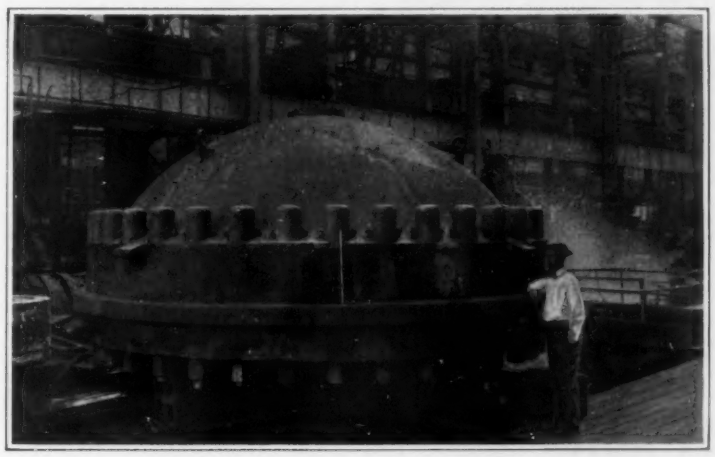
The curb ring and the cover were very difficult pieces to cast and also difficult pieces to transport to the site of the shaft. The foundry work was done by the Midvale Steel Company, while the task of installing the huge steel members is in the hands of the T. A. Gillespie Company.

The total weight of the cover piece, machined, is 92,500 pounds. Its outside diameter is 17 feet, while the outside diameter of the curb ring is 17 feet 10 inches. At first it was proposed to ship these castings by team to the Delaware River and thence on barges to Storm King *via* the Raritan Canal, because then it was considered impossible to send them by rail. However, further measurements showed that by placing the castings in well cars so that they could project below the floor of the car to within six inches of the rail, they could be transported over the Pennsylvania Railroad if taken by a round-about route. The castings had to be placed on edge because, obviously, there would not be enough lateral clearance along the roadbed if they were placed horizontally. The task of supporting these unwieldy castings in upright position was no small one, particularly in the case of the dome-shaped cover. A frame-work was built up on the car as indicated in one of our photographs, and this was well secured with tie bars, running lengthwise and crosswise.

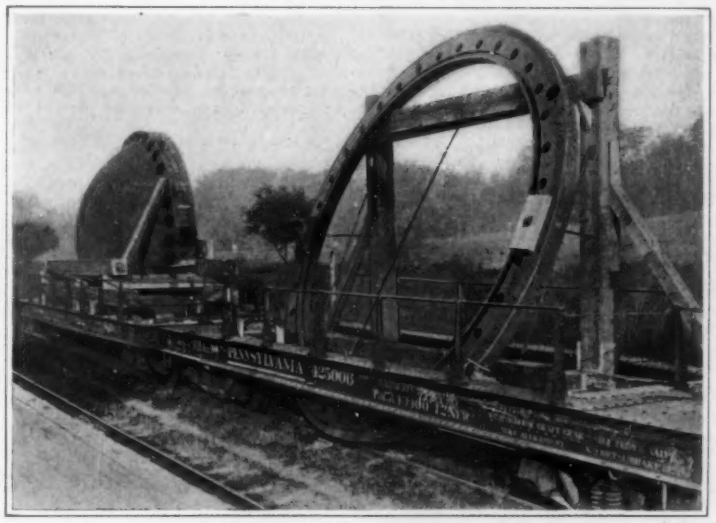
One of our photographs shows the train which transported the castings from the works at Midvale to Greenville, New Jersey. It will be seen that the castings project well above the top of the locomotive and the caboose, even though the curb ring was supported in a slanting position. At one place, namely, at Wissahickon Avenue, Philadelphia, it was impossible to pass the train under a bridge, and so it was decided to lower the railroad bed 18 inches. In order to secure the proper grade at each side of the bridge, it was necessary to reconstruct about 300 feet of the roadbed. At another place the castings tore off several bolts when passing under a bridge. The shipment was made on a Sunday, and it took 14 hours to transport the castings from Philadelphia to the yards at Greenville. The cars were very top-heavy and would start oscillating every once in a while. This made it necessary to stop the train frequently until the oscillation quieted down.

The castings have since been shipped up the Hudson and delivered successfully to within a few feet of the position they are to occupy on the shaft.

One of our photographs shows the cover under test in the Midvale shops, and fastened down with special bolts, so that it could be subjected to a hydraulic pressure of 250 pounds per square inch, for 24 hours.



The cover plate in the shop being subjected to a pressure of 250 pounds per square inch.



How the castings were mounted on the well cars.

In order to make this test, it was necessary to construct a bottom plate for the dome, 17 feet in diameter and 12 inches thick. The casting of the cover as it came from the foundry weighed 158,000 pounds, with eight 18-inch risers. After these had been removed, the weight was still 114,000 pounds.

Foreign Meat Regulations Established

THE Secretary of Agriculture on October 4th published rules and regulations governing the importation of meat and meat food products to carry out the meat section of the tariff act approved on October 3rd.

The regulations provide for foreign certifications as to ante-mortem and post-mortem inspection in countries in which the animals are slaughtered. In addition, meats will be inspected by the Department of Agriculture at ports of entry before admission. Attached to the regulations is a full list of veterinary inspectors in foreign countries whose certificates are acceptable to the United States.

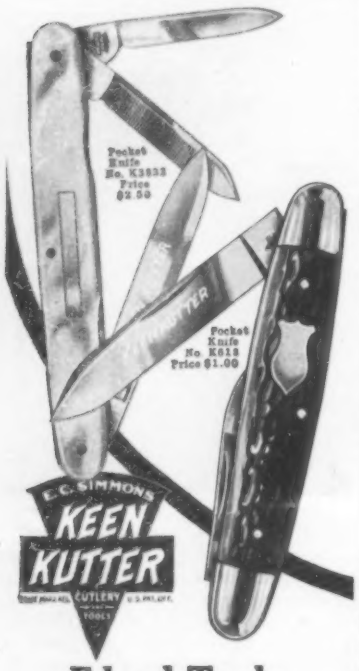
The regulations also place foreign meats after entry into the United States on the same basis as domestic meats. Heretofore imported meats have been governed entirely by the food and drugs act, and have been excluded from the establishments under the inspection of the Bureau of Animal Industry under the meat inspection act. Under the new regulations imported meats are placed under the meat inspection act after entry and thus are admitted to federally inspected establishments and are governed by the same inspection system as heretofore has surrounded interstate commerce in domestic meats. The general rule is that no meats that are diseased, contain harmful dyes, chemicals, preservatives, or other ingredients which render such meat or meat product unsound, unhealthful, unwholesome, or unfit for human food, will be admitted.

Mesothorium Treatment for Cancer

THE London *Times* correspondent in Munich reports that all Germany is obsessed with the idea of procuring mesothorium for use as a panacea for cancer. This radioactive substance is obtained from the thorium waste in the manufacture of gas-mantles. For therapeutic use a tiny particle is inclosed in a silver covering pierced with minute holes; the box is placed upon the part affected with cancerous growth, and is said to slowly but surely eradicate the disease, though leading physicians are disposed to reserve judgment on the subject. Meanwhile, says the *Times*, there is hardly a town of importance in the country that has not voted a large sum from the public funds for the purpose of purchasing some of the costly material, and where public funds are not forthcoming, concerts, bazaars, and the like are the means resorted to in order to raise money for the same purpose.

Trans-Greenland Expeditions

A PRESS despatch of August 15th from Copenhagen reports the successful termination of the Danish expedition across Greenland, under Capt. Koch. The party of four, one of whom was Dr. Alfred Wegener, the well-known German meteorologist, disembarked at Cape Bismarck, on the northeast coast of Greenland, in July, 1912. Owing to the loss of their motor-boat and an accident to Dr. Wegener their departure for the interior was delayed until the latter part of September, when the ice of Dove Bay became heavy enough for sledging. They wintered in Queen Louise Land, as planned. (See SCIENTIFIC AMERICAN, April 27th, 1912, p. 375, and November 2nd, 1912, p. 363.) During a sledge trip Capt. Koch fell forty feet into a crevasse, breaking a leg, which kept him helpless through the winter. On April 20th of this year the party broke camp and started on the 750-mile journey to the west coast. After encountering severe blizzards and killing all their ponies for food, they were rescued at Proven, near Upernivik, July 15th. News has recently been received of a trip last year across the northernmost part of the island by Knud Rasmussen and Peter Freuchen, in the course of which "Peary Channel" was proved to be non-existent; hence Peary Land is not an island, but part of Greenland.



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RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Electrical Devices.

ELECTRICAL CONNECTOR.—H. W. POGUE, 1745 N. Church St., Decatur, Ill. The inventor provides an electrical connection made up of a plug and socket adapted for separation, the plug being adapted to be carried by a sad-iron, and the socket being adapted to convey electric current to the plug which is in electrical connection with a heating coil carried by the iron.

Of Interest to Farmers.

EGG CARRIER.—E. A. DIETERICH, 910 Caldwell Ave., Bronx, N. Y., N. Y. In order to accomplish the result of protecting eggs against breakage while in transit, especially by parcel post, use is made of a receptacle, such as a box, crate or the like provided with individual cells and flexible means for yieldingly suspending the eggs one within a cell.

Of General Interest.

APPARATUS FOR COOKING MEATS.—A. R. LENDNER, Los Angeles, Cal., and FREDERICK BIGGS, Washington, D. C. Address the latter, 45 Bryant St., N. W., Washington, D. C. The primary object of this invention is to provide an apparatus for cooking meat in a sanitary manner, especially for shipment, and in which during the operation of cooking all the juices are retained and the fibers of the meat compressed into compact and solid form.

SHOT CARTRIDGE.—E. M. SWEELEY, Twin Falls, Idaho. This invention has reference particularly to a shot cartridge, and the principal object of the invention is to prevent the escape of gas which takes place after firing, thereby securing much greater velocity to the shot discharged.

CONCRETE REINFORCEMENT.—G. C. ROYSE, 5006 S. Prospect St., Tacoma, Wash. The object here is to provide in a reinforcement system means for bracing the girder in such manner as to provide the maximum resistance with a minimum of metal, and so arranged that the distribution of the metal is in accordance with the direction of the stresses.

FUSE.—J. W. HOOLEY, 1034 Lincoln Place, Brooklyn, N. Y., N. Y. This invention relates to fuses known as refillable, inclosed fuses, and refers more particularly to the class comprising a fusing member secured to members removably associated with a transparent shell inclosing the fusing member and through which the condition of the fusing member can be seen at a glance without disturbing any part of the fuse.

MEASURING SCALE.—J. A. KINCAID, 529 W. De la Guerra St., Santa Barbara, Cal. In the present patent the invention has for its object the provision of a measuring scale, with which the markings on the cross section stakes in excavating and in embankment work may be very readily determined.

HORSESHOE CALK AND CARRIER.—P. NURSE, 1300 3rd Ave., Manhattan, N. Y., N. Y. This calk has a curved plate with teeth adapted to be disposed against the inner side of a shoe, this plate having slots in which are disposed angular members, which extend upward at the outer sides of the shoe, and are provided with openings at their upper terminals, through which may be disposed a strap for securing the calks in position. The plate with the teeth may be provided with flanges to which may be secured a pad.

MEANS FOR OPERATING COCKS, VALVES, AND THE LIKE FROM A DISTANCE.—J. M. F. H. GIL, 26 Rue Boursault, Paris, France. This invention relates to means for controlling from a distance by electrical transmission, cocks, valves, etc., of all kinds and in particular valves fitted to conduits of large cross section. This means comprises mechanism for the valve actuated by a motor controlled from a distance by a hand starter which starts and stops it automatically at the end of the travel for opening the valve by means of a mechanical circuit breaker, and at the end of the closing movement by means of a maximum electrical circuit breaker in combination with an automatic device indicating the opening and closing.

PEAR BURNER.—J. J. MESSERLI and J. L. MAYFIELD, care of J. Lewis Mayfield, Corpus Christie, Tex. This burner is of the type suitable for use with hydrocarbon fuels and adapted to be manipulated directly by hand, being used for instance for burning small objects located in position not readily accessible. Its form is such as to adapt it specially for burning off the spines of cactus, prickly pears and the like.

NON-REFILLABLE BOTTLE.—C. WILCOVITZ, 147 Harrison Ave., Brooklyn, N. Y., N. Y. The bottle is simple in construction and is arranged to allow convenient pouring of the liquid contents of the bottle into a glass or other receptacle and to prevent unauthorized persons from refilling the bottle with spurious goods.

PRIMING COMPOSITION AND METHOD OF PREPARING THE SAME.—M. R. SWOPE, 718 Lagdon St., Alton, Ill. This invention relates to a new priming compound for use with explosive cartridges and the like. It has been tested in various cartridges, with a variety of makes of smokeless powder, and has been found to give a higher and less variable velocity to the projectile than the priming compounds hitherto employed.

SOUND BOX.—A. C. J. CONSTABLE, care of H. Hackfeld & Co., Ltd., Honolulu, Hawaii. The invention relates generally to sound-boxes, and more particularly it is directed to one characterized by the use of a resonance-box placed in juxtaposition to the diaphragm, but spaced from the same so that a thin layer of air is provided between the resonance box and the diaphragm within the sound-box.

Hardware and Tools.

SAW SHARPENER.—R. R. MAXWELL, Mansfield, Ohio. The inventor provides a sharpener in which the sharpening device is mounted on a shaft for revoluble movement, and in which the sharpening device will automatically travel along the shaft and along the saw to engage different teeth in succession as the shaft is turned.

Machines and Mechanical Devices.

ALARM CLOCK.—G. J. JACCARD, 247 W. 38th St., Manhattan, N. Y., N. Y. The invention produces an alarm clock especially designed for deaf people and provided with the usual bell that rings at the appointed moment; and likewise with a lamp which can be caused to light up at the same time, throwing upon the face of a person who is deaf light enough to wake him.

COPY HOLDER.—R. A. HILL, care of McMurty Hardware Co., St. Thomas, Ontario, Canada. This invention provides means by which pivoted arms may be held in one position with the member held to support the copy in position to be conveniently read and when desired the pivoted arms may be moved, when the rod will move the member relatively to the pivoted arms, so that the device will be in position to permit the typist to make notes on the member carried by the second arms. This movement will also permit the typist to conveniently reach over the device to make corrections on the typewriter when the device is disposed across the typewriter.

AMALGAMATOR.—L. O. CROCKER, Beatrice, Neb. Mr. Crocker's invention relates to an amalgamator operated by centrifugal force and adapted for general use, but especially applicable for separation of gold from crushed ores and sand when fed through the machine with water. Ore under centrifugal force is discharged against a pre-determined upper portion of the amalgamating material, under such conditions as to force this material back into the compartment rather than to cause it to overflow from the compartment.

Railways and Their Accessories.

SPIKE.—H. O. CRIPPEN, 97 Fort Washington Ave., New York, N. Y. This invention is particularly directed to improvements described in Letters Patent No. 963,280, granted to Mr. Crippen, and in a pending application Serial No. 681,262. Specifically stated the object is to provide a form of mounting for each plate so as the spike is being driven the plate will be held in operative relation with the spike, being prevented from separation due to the reaction.

RAIL CLAMP.—J. P. BRADEN, St. Paul, Minn., and W. D. PALMER, Park Falls, Wis. This clamp is for use in connection with steam shovels and similar machinery for maintaining the same immovable on the track. The device is inexpensive to manufacture, is of durable and substantial design, and is capable of being readily attached to or detached from the rail.

STATION INDICATOR.—V. M. PIECHOCINSKI, 135 W. 112th St., New York, N. Y. This indicator is for use in railway cars, street cars and other cars and vehicles running over predetermined routes, and is arranged to require no resetting by a person in charge of the car, and to enable such person to quickly and conveniently manipulate the indicator with a view to correctly display the name of the next station within the car during the outgoing trip and the return trip of the car over the route.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 9321. Want name and address of a firm who could make a machine for turning out rat buttons. The machine must be capable of making the dough of the exact size required, and also a machine to manufacture the tins and a machine for placing the dough in the tins. Preferably this machine should do all of this work in one operation.

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Inquiry No. 9329. Wanted, names and addresses of patentees of useful household utilities preferably for use in the home laundry or kitchen. This inquirer wishes to correspond with a view of purchasing patents outright.

Inquiry No. 9330. Wanted, some simple article for which there is a good demand which could be manufactured without expensive equipment, or would like an article to push if it is already manufactured.

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A Pantagraph Which Draws On Steel With a Point of Flame

(Concluded from page 300.)

applicability of the apparatus to the manipulation of the oxy-acetylene jet is evident. The jet is attached to the reproducing point, and carefully adjusted at the proper height above the surface of the metal to be cut, and when the heat is started the movements of the tracing point around the desired path on an adjacent surface, cause the metal to be cut in accordance with any prearranged plan.

It is evident that this adaptation of the pantagraph enables the use of templates to be readily effected, so that any number of pieces of similar shape may be cut, while the skill required of the operator is limited to the general manipulation of the apparatus. When, as has been found advantageous in some instances, the tracing point is fitted with a power driven wheel, the effort of the mechanic is limited to the guidance of the point, and a minimum of strength is required.

It seems altogether possible that this combination of burning jet and mechanical guiding apparatus is only the beginning of a transformation in machining methods, which may mean a much wider replacement of the older form of cutting tool than had until recently been thought possible.

How One Express Company Proposes to Compete With the Parcels Post

A NEW scheme is afoot which, for the dweller in the modern apartment house, will tend to reduce food prices and make it more convenient to obtain fresh table supplies. Strangely, this scheme sprang from the attempt which a large express company is making to retrench itself from the inroads in its business which the Parcels Post has made.

Before the days of the modern apartment building, people generally lived in houses with plenty of cellar and pantry room. They were able to buy the supplies for their tables in quantities, store them away and use them as they were needed. Buying in quantities enabled them to save on the price of many foods. Moreover, the housewife was not forced to pay for the same high standard in service. The up-to-date retailer must meet heavy expenses as to delivery and store fixtures and decorations, in order to meet competition. All of this is charged to the consumer in high prices. The problem resolves itself into answering two questions: (1) How can apartment dwellers buy in quantities, and (2) how can they eliminate from the prices they pay, the expenses of retail dealers; and, if possible, of all intermediaries that stand between themselves and the producer.

The builders of the best apartments are adding to the accommodations every year, and in many instances refrigeration from a central plant is already provided for. If in such buildings an additional cold room in the basement were added, it would make it possible and practical for a producer to deal direct with the entire building as a unit, instead of each individual family purchasing separately from retail dealers, particularly in connection with their supply of fruits, vegetables, butter, eggs, and other similar staples.

The express company in question is now trying to assist in a more economical distribution of products by bringing them directly from the farm to the table. If the cold storage room suggested above were provided, they could arrange to bring the producer and one single distributor, perhaps the superintendent of the building, together, and in that way bring about direct shipment by express from the farm to the apartment building. The result should be a continuous supply of absolutely fresh produce delivered within a few hours after being gathered in the field, and at lower prices than it is now possible to secure them through the existing complicated and expensive system of distribution. The benefit should be a direct one for the producer and for the

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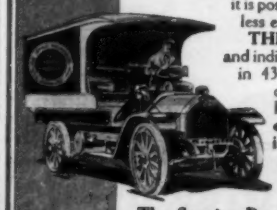


The Service Recorder Co., 2234 E. 105th St., Cleveland, Ohio
BRANCHES IN TWENTY CITIES

Hupmobile

TWO or three weeks ago Hupmobile dealers from all parts of America and Europe as well came together in convention at the factory to see this new car. And one man swept the convention by saying what everyone else had thought but had not said.

For ten minutes he had been telling of the hold of the Hupmobile on his big Western territory; and the crowd went wild when he suddenly drawled, by way of climax:—

"Boys—when yuh talk to me about competition— I— don't— know— what— yuh— mean. I never met up with it!"

And do you know, my dear sir—you who are thinking of buying a car—that this dealer merely expressed a condition that exists everywhere.

Stop and think—have you ever heard any but kind words of the Hupmobile?

Isn't it always spoken of separately—by itself?

Isn't it always singled out, and not grouped, as other cars are grouped together in a low priced class?

And do you know why?

Why This 1914 Car is Unique and Alone

The Hupmobile is in a class by itself because it has a sturdy pressed steel frame.

The Hupmobile is in a class by itself because it has a pressed steel Pullman body.

The Hupmobile is in a class by itself because it is the biggest user of aluminum of any moderate priced car.

The Hupmobile is in a class by itself because it is the biggest user of high priced steel of any moderate priced car.

The Hupmobile is in a class by itself because it has a powerful long-stroke motor, 3¼ in. x 5½ in.

The Hupmobile is in a class by itself because it has an individual, distinctive design.

The Hupmobile is in a class by itself, in other words, because by its careful and exhaustive attention to the most intimate details of construction—and by its use throughout of the finest materials obtainable, no matter what the cost—it has justified our belief that it is the best car of its class in the world.

Hupp Motor Car Company, 1233 Milwaukee Avenue, Detroit

SPECIFICATIONS

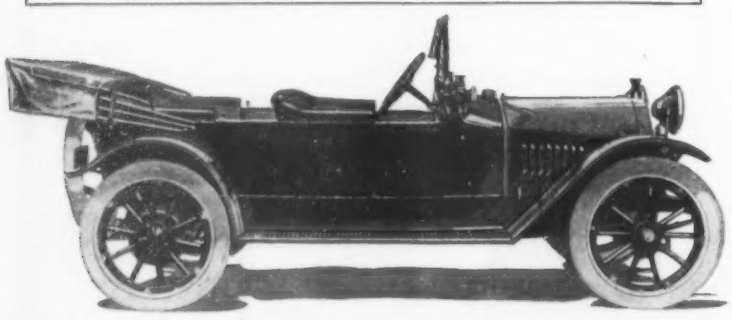
"32" Touring Car or Roadster—$1050 f. o. b. Detroit—In Canada $1230 f. o. b. Windsor

Four-cylinder long-stroke motor, 3¼ x 5 inches; unit power plant. Selective type transmission, sliding gears. Center control. Full floating rear axle. 106 inch wheel base. Tires, 32 x 3½ Q. D. Rear shock absorber. Magneto cover.

EQUIPMENT—Electric horn; rain vision ventilating windshield; mohair top with envelope; Hupmobile Jiffy curtains; speedometer; cocos mat in tonneau; Prest-O-Lite; oil lamps; tools. Trimmings, black and nickel.

"32" Touring Car or Two-passenger Roadster with Westinghouse two-unit electric generator and starter; electric lights; oversize tires, 33 x 4; demountable rims, extra rim and tire carrier at rear.

$1200 f. o. b. Detroit—In Canada $1380 f. o. b. Windsor



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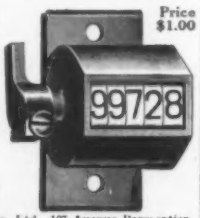

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Do you never tire of leaky unions and excessive union bills?

Of course you do, and you have but yourself to blame as long as you permit a single day to pass without investigating the Mark Union.

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Cannot leak, crack, stretch, or rust.

Send for sample union and Catalog.

MARK MFG. CO.
1903 Dempster St., Evanston, Ill.

consumer, after allowing the superintendent of the apartment building a reasonable profit for handling such goods as it might be found to be advantageous to distribute through this medium.

In this way the best farm products at prices below those of any retail store could be placed at the constant convenience of apartment dwellers.

Important Progress in Airships

By C. Dienstbach

THE new Zeppelin which made its first trial trip September 6th, differs so essentially from the many new craft of this type recently turned out at Friedrichshafen, that it marks a new epoch in aeronautics. The big dockyard was lengthened to build it, and an entirely new assembling shed is being planned for its successors. This new vessel is the "L. II.," the second airship for the German navy, and the changes are the outcome of the experiences in trying to make this type "weatherworthy" as the battleship whose consort it will be is seaworthy. There is every indication that the naval Zeppelin will become a kind of aerial "destroyer" for the fleet.

In the "L. II." the displacement has been raised to 27 tons (29,337 cubic yards). The vessel has a length of 487 feet and beam of 50 feet. The dimensions of existing sheds more easily permitted increase in beam than in length. To preserve the same strength and lightness at larger dimensions, the weight has been more evenly distributed by the addition of a third car in front of the two cars fore and aft. This new car is used only for navigating, a regular "bridge" with wheelhouse, chartroom and all other paraphernalia. The passageway is in the interior of the hull, and the cars are closer to the hull—to save shedspace. The old front car has been turned into an ordinary engine room, identical with the rear car, and it now also contains two motors.

Hence, the "L. II." is driven by four separate engines in two separate engine rooms. Without being heavier than the former type, the new Maybach motor develops a maximum of 225 horse-power in place of the former 145, giving a total of 900 horse-power for the new ship. It is claimed by the builders that this new type is the first which might cross the ocean from Europe to America without undue risk.

The first trial trip, lasting half an hour, was entirely satisfactory.

The Current Supplement

AN article by J. W. Fewkes on the geographical and historical significance of stone monuments is full of most interesting information.—H. Brot contributes an article on the manufacture of hydrogen from water gas by liquefaction. In this process the lowest temperature ever employed on an industrial scale is attained —205 deg. Cent. below the freezing point of water.—J. T. Morris reports on an investigation of the wind-pressure near a cylindrical rod. A very neat electrical method of measurement is employed in this research.—W. W. Peters writes on the development and present and future importance of the port of Galveston.—R. H. Bradbury contributes an article on colloids and crystals—two worlds of matter.

Bathing Suit Improvement Needed.—Now that the subject of bathing suits is attracting considerable attention it seems well to refer to and suggest a remedy for a difficulty attending the use of the ordinary equipment. A jersey suit when wet is hard to get off. Why cannot it be provided with suitable fastenings, say the glove fastener snap variety, so arranged that the garment may be opened and freed to such an extent that it can be easily removed? Perhaps some other remedy may be found. Considering the large number of suits used, an improvement, if a real one, should become popular, since it would not only render the use of the suit more convenient but would also relieve the strain incident to the removal of the suit now used and thus make it more durable.

My Hobby

Here's the sweetest smoke that I ever discovered, and I've smoked for 40 years.

Five Free

It is made up for me from a special Havana—a mountain-grown leaf of mild and wondrous flavor. A connoisseur who lives in Cuba picks it out for me.

It is made up only for my private use, with my monogram band. But hundreds of friends have found them out, and secured supplies through me. They have never found in a ready-made cigar such rare, exquisite flavor.

It occurs to me now that hundreds of others would enjoy this delightful smoke. So I invite those who seek something exceptional to try this Panatela.

This is not a business, for I have retired. It is merely an old man's pastime. So I will quote you a price which is close to my cost, for profit is not important. I ship by Parcel Post.

But I seek only men who enjoy the best, who want something rare, and who know good Havana. I am not after bargain-seekers.

Five Cigars Free

If you will send me 10 cents—just to show your sincerity—I will mail you these cigars. Smoke five with me—then order as wanted. The price is $5 per hundred, $2.60 for 50—all charges prepaid. Use your letterhead please, or your business card and **write now for the five cigars.**

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EXPLAINS in a simple, lucid manner, the principles and mechanisms involved in human flight, and tells how to design and construct model aeroplanes, gliders and man-carrying machines. The author's purpose has been to furnish a book on air-craft not only accurate, but simpler, more comprehensive and up to date than anything yet written. Instead of mere theories, here are actual facts and results, the experiences of noted aviators and builders.

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IN this book for younger readers the author explains simply the principles, operation, and construction of wireless transmission. He shows boys what to do and how to do it in the lines of wireless telegraphy, telephony, and power transmission, pointing out what has already been accomplished and what remains to be done. Part I. deals with Principles and Mechanism of Wireless; Part II., Operation and Use of Wireless; Part III., Wireless Telephony; Part IV., Wireless Power Transmission.

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THIS book is an introduction to electricity, carefully planned to avoid the difficulties so often met with in scientific books for young readers, and is direct and convenient in its application. Simple explanations are given for experiments and devices which every boy will love to make. There is a brief outline of the history of electricity and directions for making batteries and permanent and electro-magnets. Among the chapters are ones devoted to the telegraph, telephone and the electric motor, and to static, galvanic electricity and dynamic electricity, etc.

Illustrated, Post 8vo, Cloth, $1.00 Each.

HARPER & BROTHERS

The Nitrogen-filled Lamp

THE so-called nitrogen lamp, or more properly the nitrogen-filled lamp, is a tungsten lamp of high efficiency. It is interesting to note that ever since tungsten first came into use for lamp filaments there has been a constant endeavor to produce lamps of higher efficiency. The early work, however, was more or less a groping in the dark, for the causes that limited the life of ordinary lamps were not definitely known. The work was, therefore, largely of an empirical kind. All sorts of variations in the methods of making the filaments as well as in the methods of exhausting the lamps were tried in the hope that some might lead to an improvement in the life of the lamps.

Anything which would accomplish this result would render it possible to do the more desirable thing, namely, to increase the efficiency without sacrificing the life.

In commenting on the discouraging results of this empirical work, the *General Electric Review* states that "it was possible to improve the lamps from 10 to 20 per cent in life by certain means, but this corresponded to possible improvement in the efficiency of only a few hundredths of a watt per candle."

It was known, however, that tungsten lamps could be run at an efficiency as high as 0.20 watt per candle for a few seconds. The melting point of the filament prevented any further increase of the efficiency beyond 0.20 watt per candle. Even at 0.5 watt per candle the bulbs blackened badly within a couple of hours. The blackening of the bulb was thus the chief cause which prevented the running of tungsten lamps at very high efficiencies.

Continuing, the *General Electric Review* states:

"There were the most diverse opinions among those familiar with the manufacture of lamps, as to the cause of this blackening. There were many indications that the life might be greatly improved if a perfect vacuum could be obtained. Direct experiments to better the life by improving the vacuum were not very successful. This, however, might be taken to mean that the vacuum had not actually been improved, since there were practically no reliable methods of measuring such low pressures as exist in well-made lamps. It was, therefore, decided to grasp the bull by the horns and find out, once for all, the real cause of the blackening of the bulb, and determine the laws governing it. It was hoped that in this way a great deal of ill-directed experimenting might be avoided and possible clues to methods of preventing the blackening might be found.

"It had long been a theory that blackening was largely, if not entirely, due to the presence of gas in the bulb. A careful quantitative study of the sources of gas within a lamp bulb was made. The gases given off by the filament, by its supports, by the bulb, and the residual gases left on exhausting were measured and analyzed chemically, although often the quantities involved were less than a cubic millimeter. With this knowledge of the nature and amounts of gas that might exist in a lamp, a systematic study was made of the effects that were produced in lamps by the introduction of these (and other) gases in varying quantities into lamps. This work showed clearly that of all the gases that might exist in lamps only one, namely, water vapor, always known to be detrimental, ever produced blackening of the bulb."

The action of water vapor was, therefore, studied in detail. It was found that the water vapor attacked the filament, producing a volatile oxide of tungsten and atomic hydrogen. The oxide that thus collected on the bulb was then reduced by the atomic hydrogen. The deposit was thus changed to a black layer of metallic tungsten while the hydrogen combined with the oxygen to form water which again acted on the filament. The action of water vapor was thus a cyclic process by which large amounts of tungsten could be carried from the filament to the bulb by very small quantities of water.

Efforts were then made to study the relation between the amount of water vapor on the bulb and the rate of blackening by this cause. Pressures of water vapor even as low as 0.0001 millimeter were found to produce very rapid blackening. By methods of exhaust especially adapted to the removal of water vapor, it was finally proven that the blackening of bulbs with filaments at high temperature goes on even in the absence of water vapor. This kind of blackening was considered probably due to ordinary evaporation.

"To test this theory, quantitative experiments have been made to determine the rate of loss of weight of tungsten filaments in vacuum when run at various temperatures. This work has conclusively shown that the cause of the blackening of ordinary well-made tungsten lamps, as well as those run at higher than their rated efficiency, is simple evaporation. On the other hand, the rapid blackening of poorly made lamps is due largely to the presence of water vapor.

"When it was thus definitely known that the blackening of the lamps was due to evaporation, the problem of improving the efficiency assumed more definite form. To increase the efficiency either the rate of evaporation would have to be decreased or the evaporated material would have to be prevented from blackening the bulb. These considerations have led to several different methods of attack, of which the following are particularly interesting:

"1. Introduction of gases, such as nitrogen or mercury vapor at atmospheric pressures into the lamp bulb.

"2. Changing the location of the deposit by means of convection currents in gases, so that the bulb opposite the filament does not darken.

"Each of these methods has been tried with marked success.

"The use of a gas at high pressure causes the loss of heat from the filament by convection. This makes it necessary to run the filament at a higher temperature than in a vacuum even to get the same efficiency."

The question arises: Are the advantages to be gained by the use of a gas sufficient to offset the tendency for an increase in the rate of evaporation owing to the higher operating temperature?

This the *General Electric Review* answers thus:

"Simultaneously, with a large part of the preceding work, several investigations on the heat losses of wires in various gases had been under way. It had been found that the heat lost by convection increases only slowly with the temperature of the filament, approximately proportional to the 3/2 power of the temperature. The radiated energy, on the other hand, increases with about the 4.7th power of the temperature. At very high temperature the effect of convection currents therefore becomes *relatively* small. It had also been found that the heat loss by convection from small wires at high temperatures is very nearly as great as that from wires several times as large in diameter. In other words, the cooling effect of the gas on the filament is much more serious in the case of small filaments than in the case of large ones. For example, a straight filament 0.001 inch in diameter run in nitrogen at atmospheric pressure and at a temperature corresponding to that of a filament running at 1 watt per candle, will give an efficiency of only about 4.8 watts per candle. On the other hand, a filament ten times as large (i. e., 0.010 inch) will give at the same temperature an efficiency of 1.59 watts per candle.

"It is thus of great importance to use filaments of large diameter. Practically the same effect can be obtained by winding the filaments into the form of a tightly coiled helix."

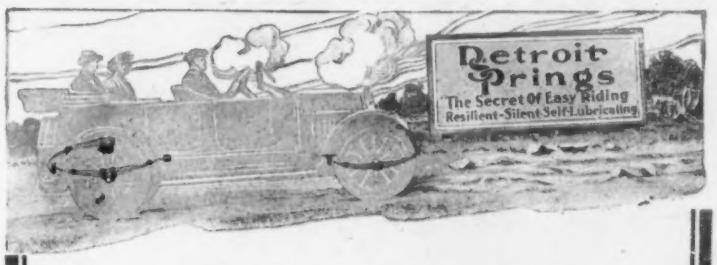
From the foregoing considerations it is clear that the larger the diameter of the helix the higher the efficiency that may be obtained. The diameter of the helix is ordinarily limited by the sagging which is apt to occur if the mandrel on which the helix is wound is too large in proportion to the size of the wire.

With helically wound filaments in nitrogen very high efficiencies can be obtained and yet the life of the filament may be more than 1,000 hours. The blackening of the bulb is avoided; and in properly designed bulbs the tungsten that evaporates produces only a slight brownish deposit in the upper part of the bulb, where it does no harm. A number of types of nitrogen-filled lamps have been made and tested. Among these the most interesting for the present are perhaps the following:

"1. *Large units of very high efficiency.* (0.4-0.5 watt per candle with a life of 1,000 hours or more.) These take currents of at least 20-30 amperes and (except in units over 4,000 candle-power) are therefore best run from alternating current circuits by means of small transformers giving a voltage depending on the size of unit desired.

"2. *Smaller units of low voltage.* These take currents of ten amperes or less, at voltages, in some cases, as low as four or five volts. The efficiencies with 1,000 hours life vary from 0.6 to 1 or even 1.25 watt per candle, according to the current used. These lamps are adapted for series street lighting on 6.6 ampere circuits (at about 0.7 watt per candle); for stereopticon lamps, automobile headlights and in general, wherever a source of high intrinsic brilliancy, steadiness and white color is needed.

"3. *Lamps to run on standard lighting circuits* (110 volts). Large units of this type (several thousand candle-power) have efficiencies of 0.5 watt per candle or better. With



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Do You Specify the Springs As Carefully As You Select
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The basis of Detroit Spring super-quality is steel fabricated in an electric furnace according to formulas based on tests by D. S. P. engineers and chemists. It comes to us in heavy tonnage lots, is carefully analyzed to meet our own formulas, and is not allowed to vary in chemical composition by ½% of any element. The result is that the Detroit Spring is *begun right*, and every step therefrom through the many handlings and refinings it receives is marked by the same attention to its fundamentals. From the shearing of the first leaves to the last detail of the "capacity test" no road and no speed ever try a Detroit Spring beyond the exactions of our own shops.

Our spring engineers first *design* the length, height, arch, number of leaves and capacity to which every set of Detroit Springs must be built. Cost of manufacture has never counted, but rather the *requirement to be met*. Each spring is *built to order* in our shops, specified in detail to accommodate line and load and type of car, so that the car owner is assured that he is *riding on the right springs for his car*.

"Eye-making," for example, is only one of the many vitally important processes of Detroit Spring work, which must be 100% accurate. Each of the three operations of "scarfing," "curling the eye" and "truing" is a job for the skilled man only. Our "eye men" have done nothing else for years. Equal precision marks the "rolling" of each leaf to the taper that is *right for that spring*.

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A new patented feature of Detroit Springs is the Self-Lubricating Device. This revolutionizing feature consists of a distributing reservoir in each leaf, loaded with long-life lubricant—which lubricant enables the leaves to softly, silently slide one over the other with every movement of the spring, producing a velvety resilience not to be found in any other spring. Because of this patented device the day of squeaking, noisy springs is past.

RESILIENT Detroit Springs SILENT—SELF-LUBRICATING

You Can Know Detroit Springs By the Lubricating Cup Near the End of Each Leaf—and the Above Trade-mark.

One of the Standard Tests that Insure Detroit Spring Serviceability

Under the "capacity test" every Detroit spring must carry a fixed load at a fixed height—never less. This machine sees to it that this infallible law of D. S. P. manufacture is never infringed.

A Two-Year Guarantee

We protect you for twice as long as usual. And we run no risk in doing so because we make the springs to protect ourselves as well as you.

Our bushings are all of special bronze and are polished as satin smooth as a piano's finish. Careless spring-eye or bushing finishing often makes a difference of 3 years in the duration of *silence* in the spring.

And instead of the cheap, dirt-catching "lip" method of retaining spring leaves, Detroit Springs are slotted on one side and beaded on the other, near the ends. This prevents all chance of lateral movement of leaves when the spring is deflected. Each leaf is triple-heated to insure scientifically correct temper, each heating being controlled by our special Thermo-Electric Pyrometers.

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A tent large enough to shelter his vast army, yet so small that he could fold it in his hand, was the gift demanded by a certain sultan of India of his son, the prince who married the fairy Pari-Banou.

It was not difficult for the fairy to produce the tent. When it was stretched out, the sultan's army conveniently encamped under it and, as the army grew, the tent extended of its own accord.

A reality more wonderful than Prince Ahmed's magic tent is the Bell Telephone. It occupies but a few square inches of space on your desk or table, and yet extends over the entire country.

When you grasp it in your hand, it is as easily possible to talk a hundred or a thousand miles away as to the nearest town or city.

In the Bell System, 7,500,000 telephones are connected and work together to take care of the telephone needs of the people of this country.

As these needs grow, and as the number of telephone users increases, the system must inevitably expand. For the Bell System must always provide a service adequate to the demands of the people.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

smaller units the efficiency is ordinarily not so high.

"Besides their high efficiency, there are certain features of the new lamps which may prove of advantage for certain cases.

"1. *Color of the light.* The temperature of the filament being several hundred degrees higher than that of ordinary tungsten lamps, causes the light to be of a very much whiter color, so that it comes closer to daylight than any other form of artificial illuminant except the direct current arc and the special Moore tube containing carbon dioxide. The color is almost exactly like that which can be obtained for a few minutes by running an ordinary tungsten lamp at double its rated voltage.

"By the use of special color screens it is possible to obtain a true daylight color at an efficiency of about 2 watts per candle whereas with ordinary tungsten lamps the efficiency obtained with the proper screens is only 10-12 watts per candle.

"2. *High intrinsic brilliancy.* The intrinsic brilliancy is five to ten times that of the filament of the ordinary tungsten lamp. This renders it especially suitable for projection work such as headlights and stereopticons. Although the intrinsic brilliancy is less than that of the arc, this difference is often more than offset by the fact that the wandering of the crater of the arc prevents as sharp focusing as is possible when the source of light is fixed in position.

"3. *Constancy of the characteristics during life.* Because of the freedom from blackening of the bulb in these lamps and because the helically wound filaments may be so designed that the sagging compensates other changes during life, it is possible to make nitrogen filled lamps which maintain their volt-ampere candle-power characteristics practically constant during their whole life. The ultimate failure of these lamps is due to the breakage of the filament. The candle-power is usually well above 80 per cent, even just before failure."

A Scotch Manufacturers' View of American Industrial Conditions

IN the *Western Supplement and Advertiser* of the *Scotsman* for August 16th, appears a letter from Mr. John Muir, a leather manufacturer of Beith, in which he presents a very interesting picture of American industrial conditions as he found them during a recent visit to the United States.

"In the vast corn belt where the chief product costs about 25 cents a bushel to the farmers," says Mr. Muir, "they have had an unlimited market at over 50 cents, and are now realizing up to $1 a bushel for it in the form of hogs, owing to the high price of bacon.

"With the scope there in developing a new country and with well-remunerated effort, population has naturally increased till that of the United States to-day is double that of Great Britain.

"Manufacturing enterprise has been stimulated by this agricultural and general prosperity till the exports of the United States have for the first time exceeded those of Great Britain this year.

"The Americans are a nation of mechanics organized by men who know how to get and how to keep business. Backed up by nature as their powerful ally and an ever-expanding home market, they are able and willing to now rapidly capture export trade. They turn out 65 to 70 per cent of the world's motor cars already.

"In Canada where a preference duty of 60 per cent is given to British makers, the Americans have already captured that market. A British car is rarely to be met with. Yankee enterprise is thus circling the globe, and it looks to me as if they intended that we should be left only with a congenial atmosphere in which to congregate around the parish pump to 'wait and see' them in full possession of the export trade in that industry."

Some New Peter Cooper Hewitt Patents.—Peter Cooper Hewitt of New York has secured patent No. 1,069,695 for vapor electric apparatus and No. 1,069,696 for a starting device for vapor apparatus. The former provides a plurality of negative electrodes and a common positive electrode in connection with a separate work circuit connected with each negative electrode, while the latter provides in connection with other parts electrical devices by which on the extinguishment of one or two vapor devices, a starting current will be developed for initiating the flow of current through the other device.

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250 Candle Power—1 hours for 1c. Decorated China Shade furnished free with each lamp. Beautiful, artistic; the best and handiest home or office lamp ever invented. Also 500 other styles of gasoline and kerosene lamps. AGENTS WANTED. A permanent, steady position at good pay to right parties.
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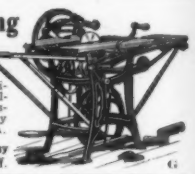

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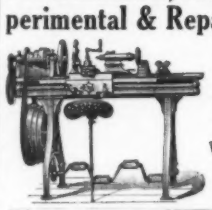

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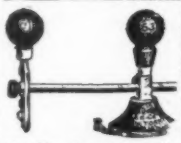

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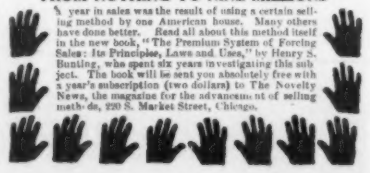

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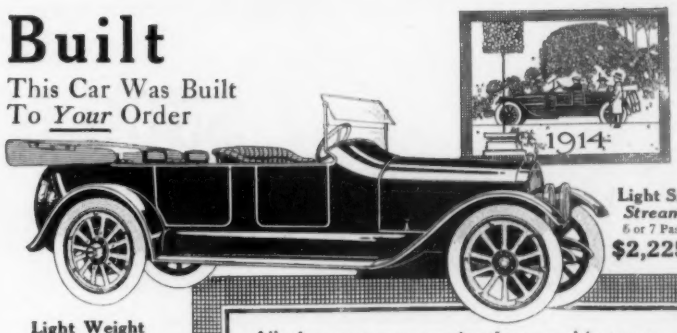

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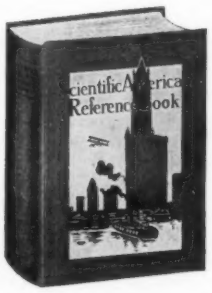

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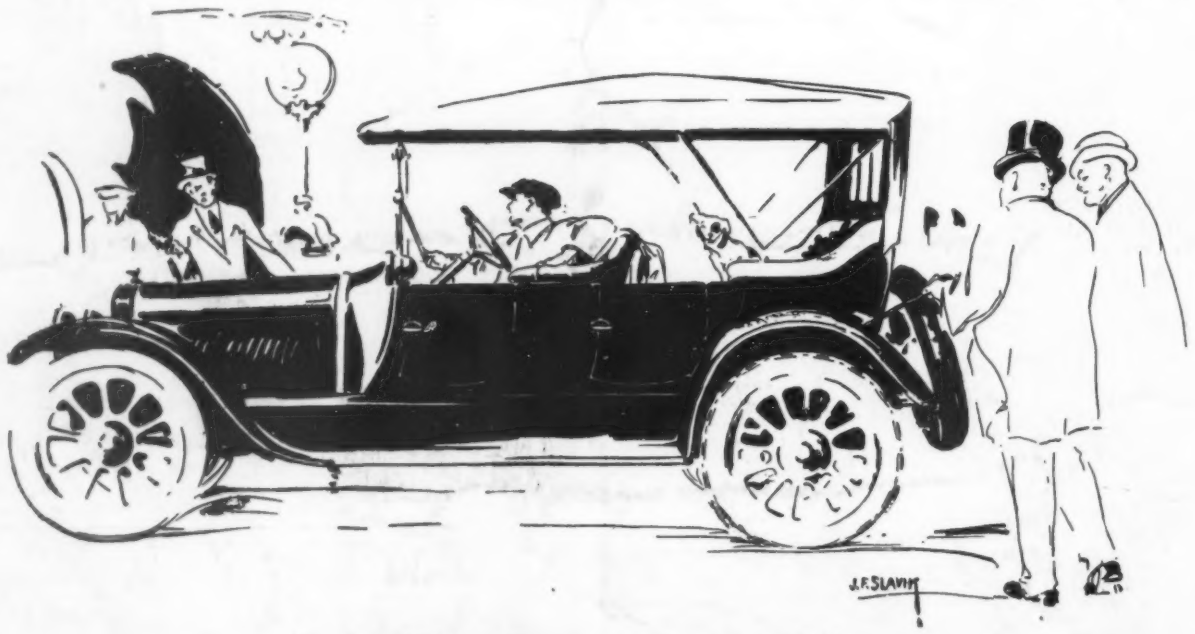

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